

# CURRENT SCIENCE

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## SCIENTIFIC AWAKENING

PROFESSOR A. V. HILL'S dynamic visit to twelve Indian cities between mid-November, 1943, and early April, 1944, gave much comfort to the scientific community, and he now gladly testifies to the great goodwill universally manifested towards his mission. This lay in acquainting himself with the state of scientific and industrial research in this country, and thus equipping himself to advise the Secretary of State on the organization of scientific endeavour as a part of Indian post-war reconstruction; and on its co-ordination with similar activities in Britain. His report\* is rich in proposals directed towards development of Indian resources in men and material; its interest and importance are outstanding.

Immediately on his return, Prof. Hill procured an official invitation to a group of Indian scientists led by Sir Shanti Swarup Bhatnagar, Head of the Board of Scientific and Industrial Research, to visit British factories, laboratories and institutions concerned with linking scientific procedure to public needs. This embassy having later journeyed to the United States and Canada, returned to India in mid-February, and it is reasonable to hope that its members may come to be regarded as apostles of a new era; for their unique experience will authorise them to select and urge the adoption of such among Prof. Hill's proposals as they deem best applicable to Indian conditions.

The first of these relates to medical education, upon which as a physiologist Prof. Hill is highly qualified to judge, and his verdict is that the development of scientific medicine re-

quires one first-class department of physiology at which teachers and research workers of a new standard and a new outlook will be reared, and thence distributed throughout the country. There is the same need for intensified "anatomy and pharmacology in the medical colleges; and there is little provision for psychology. Biochemistry is in rather better case because it has developed a certain independence of medicine, has had a special part to play in relation to nutrition and has connections with agriculture and industry. It will be a pity, however, if biochemistry is encouraged to develop mainly as a branch of chemistry in order to avoid the narrowness and penury of the medical connection. It should be just as closely in touch with physiology, pathology and medicine as with chemistry, agriculture and industry."

This proposal calls for an All-India Medical Centre, "an Indian Johns Hopkins", throughout staffed by the ablest people available anywhere, employed full-time and adequately paid. The selected students should be graduates in arts or science, and when requiring monetary help should receive enough to cover their long training with the aim of producing future leaders among medical teachers, researchers and practitioners. Moreover, selection should be regardless of all considerations other than quality, because "if any reason whatever were accepted for admission other than ability and character the project would lose at once a large part of its value." Greatly improved health being India's first need, the All-India Medical Centre should be established at a cost of Rs. 7 to 10 crores in the capital city, and might form a suitable national memorial to the Indian Forces, whose gallantry in World

\* *Scientific Research in India*. Professor A. V. Hill, M.P., Sc.D., Sec. R.S. (Government of India Press, Simla), 1944, pp. 40.

War II has evoked gratitude and admiration throughout the Commonwealth. A substantial part of the running cost might be met by accommodation for paying patients as at the Mayo Clinic, where fees are adjusted to the patient's income. A specialised section for the clinical study of malaria, with (say) 200 beds, would form an appropriate recognition of both India's Public Enemy No. 1 and the large part this country has already played in coping with tropical disease.

The second major proposal envisages a Central Organization for Scientific Research, which would embrace collectively the functions now exercised in England by the Medical Research Council, the Department of Scientific and Industrial Research, the Agricultural Research Council, the War Cabinet Scientific Advisory Committee, and the Surveys. It would work under the Hon'ble Member for Planning and Development and would comprise six Research Boards, namely, Medical, Agricultural, Industrial, Surveys and Natural Resources, Engineering, and the War Research Board. After outlining the composition and duties of these boards, Prof. Hill indicates the working of committees, including those for grants and studentships, showing also how a Scientific Consultative Committee, recruited from each Board and fortified by six unofficial members could usefully advise the Hon'ble Member.

It will be recognised that this proposal, if adopted, will separate research from direct control of the departments under which it is at present practised, a policy which has been closely examined by Prof. Hill and for which he adduces cogent arguments. He believes that any temporary disadvantages caused by the detachment would be liberally compensated by "more and better research", following improved co-ordination of the various branches of inquiry resulting from disclosure of existing gaps and weaknesses. Moreover, departments now benefiting by such research as they do control could retain this advantage through a Development or Improvement Council set up within the department to apply research results to the various practical problems in view. Such a council, if including members of the relevant Research Board, would offer the twofold benefit of (1) keeping the Board aware of practical needs and (2) ensuring that research results come to the notice of those whose duty it is to apply them. The "more and better research" would follow release from the trammels of departmental need, as it is "a mistake in general to tie up research too directly to the solution of immediate practical problems."

Furthermore, assemblage of all research branches in a central organization provides one inestimable advantage which is not mentioned in the report. It would greatly facilitate that association and consultation among the scientific personnel which Indian distances now preclude, and which have been immensely helpful to geographically more fortunate nationals. The Indian Science Congress Association dating from 1914 was designed to mitigate the distant handicap from which most Indian scientists are compelled to suffer; but even that provides only one fleeting annual

alleviation of a few days, and cannot embrace all the juniors, who are the very people most needing the benefit. A Central Organization for Scientific Research located at Delhi with an adequate library would supply an increasingly fertile pool of science personnel and practice which might ultimately be comparable with those of London, Washington, Moscow and Paris. From this concentration of effort and opportunity special benefit would accrue to investigators of those regions in which two or more branches of science are intermingled. Looking further into the future, inevitable social exchanges between members of the science group and their governmental neighbours may be calculated to produce reciprocal enlargement of sympathy and outlook.

It cannot be denied that there is unlimited scope for this bilateral broadening of outlook and sympathy. Owing to the common exclusion of sciences from school curricula, many people attain highly responsible positions in the community without any clear idea of the mental processes which yield scientific discoveries, and with no conception whatever of experimental methods. They could not, for example, describe the very simple operation of resolving air into nitrogen and oxygen although they depend on air for every minute of their existence. It is even more significant and regrettable that they have no curiosity in the matter. A glaring example of this unhappy principle has lately emerged in a popular book whose world-renowned author—presumably serious for a moment—roundly charges researchers with manufacturing their evidence; in laboratory slang, with "cooking their results". The shocking aspect of this almost incredible episode is that, owing to the high entertainment value of the author in question, and his usually penetrating vision, this calumnious dictum will reach a very large circle of readers, most of whom will fail to diagnose the mental aberration and will rashly assume that because he is a super-sparking playwright his opinion of other matters must be trustworthy.

From an early stage of the report there springs the question, Where shall we find the men? On a much larger scale it haunts the Sargent Scheme, and is foundational to both compulsory national education and scientific awakening. Among intellectual disasters consequent on the war has been the isolation of India during five years, and "one of the most urgent needs, therefore, of Indian science, medicine, technology and industry is for young teachers, research workers and members of technical staffs to be provided once more, as soon as conditions allow, with facilities for advanced study abroad; if possible, on an enlarged scale in order (a) to make up for recent restrictions and (b) to meet the greater needs of the future." Following the lately returned Foreign Mission of Indian Scientists there is happily no doubt that carefully selected Indian practitioners will be welcome in the laboratories of Britain and the United States, the only obstacle to their acceptance being limitations of space arising from arrested training of those nationals, and consequent overcrowding of laboratory accommodation,

accentuated by the priority claimed in England for domestic housing.

Any outlay on this project by Government within the limits of available space will be a splendid investment. During many decades preceding World War I it had been common practice for advanced British and American students of science to enter German universities, even after their own teaching personnel and laboratory equipment had attained the German level: besides improving their knowledge of the language such students benefited by observing another way of life. Many years—perhaps another generation—must pass before German universities again become harmoniously accessible by foreigners, and meanwhile Indian students must be liberally subsidised to enjoy such facilities as may be obtainable elsewhere. This would not only provide India with a pool of technicians trained in all branches of science and medicine, but would lead to an improved mutual understanding of East and West. To promote these and other contacts, Prof. Hill advises establishment of an Indian Scientific Office in London, co-operating with the British Central Scientific Office in Washington, and thus enabling India to profit by American experience in soil-conservation, irrigation, hydro-electric developments, pest-control and many other problems common to the American Continent and India. Another factor in assembling a reservoir of trained technicians suggested by Prof. Hill is the provision of facilities for technical training at all important centres, ancillary to a few technical institutes of the highest possible standing; either newly constructed, or developed from existing ones, of which he considers the Indian Institute of Science, Bangalore, to be the one approaching most closely to the ideal sought. The principle is the same as that underlying the proposal for an All-India Medical Centre noticed above, and “the cost will be considerable, but if Indian industry and agriculture are to be developed to the highest level by Indians, and if Indians of the required quality are to staff the new national laboratories to be built under the Board of Scientific and Industrial Research after the war, then Indians must be trained to the highest level themselves. Nationalist fervour cannot replace first-class scientific ability and technical training.”

Scientific awakening has come to other nations through the war, and India must not

lag behind. Addressing the East India Association in July 1944 on the results of his Indian mission Prof. Hill gave his emphatic summary in the words, “Scientific Development or Disaster”. Faced with the standing threefold menace of ignorance, ill-health and malnutrition, India is threatened with the future calamity of a population overflowing the limits of her agricultural resources, because one immediate result of improved nutrition is reduced mortality. “In quality and calories together India needs at once at least 50 per cent. more food than she now has; give her that and her population will increase not by 15 per 1,000 per annum but by 20 or 25—it is already 20 in the Punjab. Then in 30 years or so the food supply will have to be doubled again, to be three times what it is now.” A threefold increase in thirty years demands a stupendous national effort. New land must be brought into cultivation involving irrigation, and proper maintenance to avoid erosion. Roads, railways and bridges must be built, and transport multiplied. Wide improvement in the breeding of plants and animals must be effected, and insect-pests mercilessly combated. Soil chemistry must be studied and applied. Every known means for battling waste must be operated, so that all useful ingredients may return to the land. Afforestation must be stimulated, if only to avert the lamentable destruction of cowdung as fuel and redirect it to its proper destination, the soil.

There are many other matters discussed by Prof. Hill in his report, including Indian scientific societies and the various ways in which Government might assist and encourage them; for instance, by purchasing a certain mileage of air-travel for distribution among such bodies. His fruitful, sympathetic and stimulating visit followed by this wealth of practical proposals, will provide abundant material for reflection, discussion and construction during many years to come, the whole event being unique in the scientific life of this country. In conclusion, it is worthwhile to quote a significant passage in Prof. Hill's preface to the report: “I have assumed throughout that the scientific method, rightly and confidently used, will provide the framework within which national development will be planned by Indians for India. In their task they can be sure of the co-operation and goodwill of their scientific colleagues elsewhere. No other method can possibly succeed.”

M. O. F.

## ADVANCED STUDIES OVERSEAS

**ARRANGEMENTS**, it is understood, are now complete for sending students overseas for advanced studies. In addition to the provision made for stipendary students, the Government of India are also making arrangements for assisting in placing in foreign institutions of those students who desire to proceed overseas for advanced studies at their own expense.

The Government of India, in addition to the students sponsored by Provincial Governments, will send overseas a number of students who will receive adequate stipends for further education and training in various branches of

Technology, Applied Science and Agricultural subjects. Government servants will also be eligible for stipends, and they may also be sent overseas at their own expense.

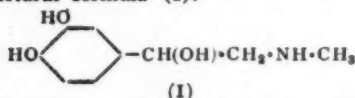
Applications are being invited to reach the Selection Board (Overseas Students) set up by Education, Health and Lands Department by April 15, 1945, on a special form which has been included in a booklet *Information for Students Desiring to Proceed Overseas for Advanced Studies* (1945), being issued by the Manager of Publications.

## THE SYMPATHOMIMETIC GROUP OF DRUGS

By S. RAJAGOPALAN

(Department of Pure and Applied Chemistry,  
Indian Institute of Science, Bangalore)

ONE of the earliest and possibly best known studies in correlating chemical structures and pharmacological behaviour was made with compounds that produce a rise in blood pressure. Interest in these compounds was aroused when Oliver and Schaefer<sup>1</sup> in 1894 and Scymonovicz<sup>2</sup> independently in 1895 found that extracts of the suprarenal glands, when injected intravenously in experimental animals, caused a swift and precipitate rise of blood pressure and produced all the changes which occur when the animals are preparing for battle, such as the quick pulse, the dilated pupil and the inhibition of the peaceful activities of the abdominal viscera. The subsequent analytical<sup>3</sup> and synthetic<sup>4,5</sup> experiments have proved conclusively that the active principle, responsible for this effect, viz., adrenaline, possesses the structural formula (I).



More recently, the discovery of its possible function as a transmitter of certain nervous impulses has played a fundamental part in the evolution of physiological and pharmacological concepts.

Before 1905 the existence of internal secretions of certain glands had been proved by circumstantial evidence, but nothing was known in regard to the chemical composition of the active principles responsible for their vital physiological activities. Apart from the demonstration of the comparatively simple composition of adrenaline, it was the first hormone to be synthesised and there is no doubt that this rapid success with the chemistry of adrenaline gave an impetus and encouragement to the successful chemical study of other hormones.

While the interest in adrenaline is usually associated with its presence and functions in the higher animals, it is found in structures other than the suprarenal glands. Abel and Macht,<sup>6</sup> and many other workers have shown the presence of adrenaline or similar bodies in the venoms of different toads. Collip<sup>10</sup> has demonstrated the presence of an adrenaline-like substance in the prostate gland of the bull.

While the fame of adrenaline was thus steadily rising, Abelous *et al.*<sup>11</sup> made the interesting observation that extracts of putrefied meat also contained a substance that produced a rise in blood pressure. Barger and Dale<sup>12</sup> identified the active ingredients as two definite compounds, isoamylamine and tyramine. Since both may be derived by putrefactive processes from the amino acids leucine and tyrosine respectively, they were led to investigate other bases of putrefactive origin and also substances structurally related to adrenaline and tyramine: their results<sup>13</sup> first showed that an intimate relationship existed between the physiological

activity of compounds possessing structural similarity. Because all of the substances investigated caused a rise in blood pressure by constricting the muscular lining of the arterioles, Barger and Dale described them as "Sympathomimetic", a term which is now in the vocabulary of all physiologists and pharmacologists.

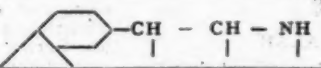

During the fourteen years following the work of Barger and Dale in 1910 nothing of particular interest developed; known compounds were more intensely investigated and occasionally new ones, without special merit, were introduced. Meanwhile, adrenaline was becoming more firmly established and was being more extensively used than any other compound in physiological and chemical investigations, thereby illustrating the important position occupied by adrenaline in therapeutics, diagnoses and physiological experiments and even as a chemical reagent. However, in 1923, Chen<sup>14</sup> demonstrated that a decoction of the Chinese Ma Huang, a plant of the *ephedra* species, containing the active principle ephedrine, produced an action on blood pressure simulating that of adrenaline. Chen and Schmidt, the modern sponsors of ephedrine, have covered the history, chemistry and drug action of ephedrine in a monograph.<sup>15</sup>

Once the chemical structure of adrenaline has been elucidated it was natural that attempts should have been made to determine whether the molecule in its entirety was necessary for exerting the particular action of adrenaline. Much of the ground was covered by the pioneer work of Barger and Dale.<sup>13</sup> The molecule of adrenaline is such as to have encouraged the ingenuity of organic chemists, who have prepared a series of over 200 substances containing most of the permutations and combinations of the peripheral groups, of which the following are better known:—

All these substances have pharmacological action like adrenaline in varying degrees. Some of them which have been adequately covered in medical texts and have formed the subject of some excellent reviews<sup>16</sup> recently, have great advantages over adrenaline as therapeutic agents.

An examination of the group reveals an interesting relationship between chemical structure and pharmacological action. With an ethylamine side chain, the result of adding hydroxyl groups to the benzene ring is to increase the intensity but diminish the duration of pressor action. It can also be seen from the table that the addition of a single hydroxyl group, especially if it be in the *m*-position, increases the intensity but diminishes the duration of action. It is interesting to note that the stability of the compound is diminished if the hydroxyl groups are attached to the benzene ring; this explains why adrenaline solutions cannot be sterilised by boiling, whereas for example, those of neosynephrine (No. 4) can. It will be noticed that the first eight compounds have a methylene,  $-\text{CH}_2-$ , group in the  $\alpha$ -position to the amino group in the side chains. In the remaining compounds, one of the hydrogen atoms of this group is replaced by a methyl radical, which has the effect of prolonging the duration of the pressor effect, although

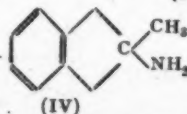
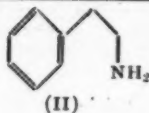


No.	Name						Pressor Activity (Adrenaline = 1)	Pressor Duration (Adrenaline = 1-h)
1	$\beta$ -Phenyl Ethylamine	H	H	H	H	H	1/200-1/80	3-4
2	Tyramine	HO	H	H	H	H	1/100-1/20	2
3	Synephrin	HO	H	H	H	CH <sub>3</sub>	1/50	10
4	Neosynephrin	H	H	HO	H	CH <sub>3</sub>	1/25	5
5	Symp.tol	HO	H	HO	H	CH <sub>3</sub>	1/100-1/25	4
6	Epinephrine	HO	HO	H	H	CH <sub>3</sub>	1/12	2
7	Arterenol	HO	HO	HO	H	H	3/2	2
8	Adrenaline	HO	HO	HO	H	CH <sub>3</sub>	1	1
9	Benzedrine	H	H	H	CH <sub>3</sub>	H	1/300-1/100	5-10
10	Propadrine	H	H	HO	CH <sub>3</sub>	H	1/300-1/60	7
11	Ephedrine	H	H	HO	CH <sub>3</sub>	CH <sub>3</sub>	1/300-1/100	7
12	Veritol	HO	H	H	CH <sub>3</sub>	CH <sub>3</sub>	1/30	10
13	Corbasil	HO	HO	HO	CH <sub>3</sub>	H	1/4	2
14	Methylenedioxy, $\beta$ -phenyl isopropylamine			H	CH <sub>3</sub>	H	1/400	10

the intensity of the latter is slightly diminished. It has recently been shown that adrenaline is readily destroyed in the body by an oxidase, which attacks the side chain and thereby inactivates it pharmacologically.<sup>17</sup> At the same time it was shown that this oxidase attacks phenyl ethylamine, tyramine, sympatol and epinephrine (Nos. 1, 2, 5, 6), but not benzedrine, ephedrine or corbasil (Nos. 9, 11, 13), which have a methyl group in the  $\alpha$ -position. This explains why the last named compounds have more prolonged effect in the body and perhaps why, unlike adrenaline, they are active when orally administered.

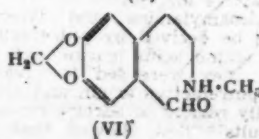
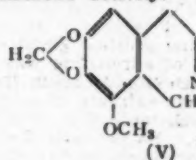
Adrenaline has practically no action on the central nervous system, but ephedrine and especially benzedrine have a marked stimulant action. Increased stimulation of the central nervous system is caused by compounds in which the benzene ring is not substituted, e.g., benzedrine, propadine and ephedrine (Nos. 9, 10, 11) and in compounds containing an isopropyl side chain,  $-\text{CH}_2\text{CH}(\text{CH}_3)_2\text{NH}_2$ . The stimulant action is enhanced by introducing a methylenedioxy group,  $-\text{OCH}_2\text{O}-$ , into the benzene ring (No. 14), or replacing this by a cyclohexanyl nucleus. Such compounds which have recently been prepared cause marked acceleration of respiration and increase of motor excitement.

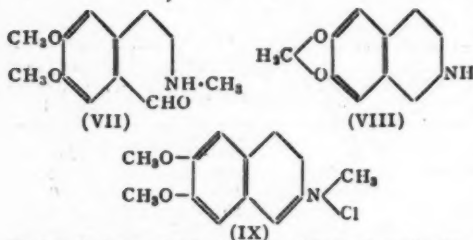
In examining the general pharmacological activities of this group of bases, one cannot fail to be struck by the regularity with which the atom-pattern,  $\text{C}_6\text{H}_4\text{CH}_2\text{CHNH}_2$  occurs in their molecular architectures. However, sympathomimetic activity is not exclusively restricted to the  $\beta$ -phenyl-ethylamine derivatives. Fourneau,<sup>18</sup> among others, has drawn attention to the way in which this type of aralkyl structure is usually accompanied, in even nonbenzenoid substances, with characteristic sympathomimetic activity. Thus, this activity which is observable in  $\beta$ -phenyl-ethylamine<sup>13</sup> (II) is more strongly pronounced in  $\alpha$ -tetrahydro- $\beta$ -naphthylamine<sup>19,20</sup> (III) and intense in methylamino-hydrindene<sup>21</sup> (IV).



The activity of tetrahydro- $\beta$ -naphthylamine has been attributed to its being a derivative of  $\beta$ -phenyl ethylamine (II) in addition to its resemblance to  $\gamma$ -phenyl propylamine and cyclohexenylamine.<sup>19</sup> The high activity of methylamino-hydrindene (IV) has been explained on the basis of its being doubly a  $\beta$ -phenyl-ethylamine. Curiously enough, this activity, unlike that of phenyl-ethylamine, is not enhanced by the entry of a hydroxyl group into the aromatic ring.

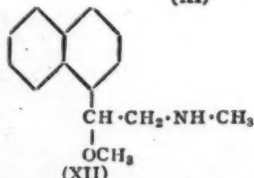
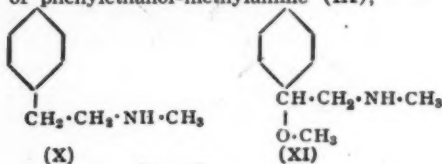
Evidence of this interesting phenomenon is also to be seen among the group of isoquinolines,<sup>22</sup> of which  $\beta$ -phenyl ethylamines constitute the precursors. The structurally related bases, cotarnine (V), hydrastinine (VI), the hydrastinine-like base (VII) and norhydrohydrastinine (VIII) exhibit varying grades of sympathomimetic activity.



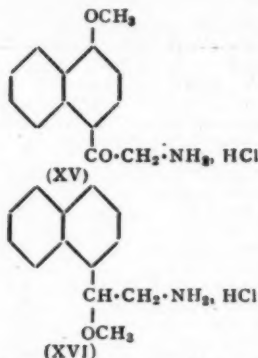
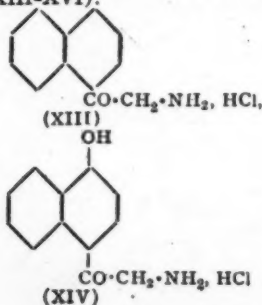


Hydrastinine, which is an astringent and styptic, is used chiefly in uterine hæmorrhages. Cotarnine is of importance in medicine as a styptic and as a uterine sedative and is known as 'Stypticine'; its phthalic acid salt also finds use under the name 'Styptol'. The chloride of (VII), 6:7-dimethoxy-2-methyl-3:4-dihydroisoquinolinium chloride (IX), has been introduced in practice as 'Iodal'. It causes a rise of blood pressure and renders the heart-beat slower and stronger.

The activity of  $\beta$ -naphthyl-ethylamine derivatives was investigated by Madinaveitia.<sup>23</sup> By comparing the activity of  $\beta$ -phenyl-N-methyl-ethylamine (X) with the methyl ether of phenylethanol-methylamine (IX),

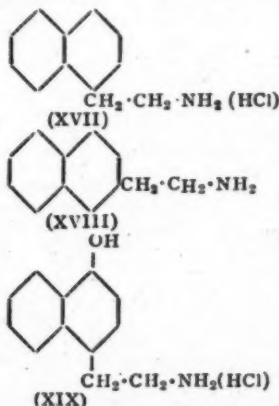


he showed that the introduction of the methoxyl group in the side chain did not change the sympathomimetic activity; but if the  $\alpha$ -naphthyl nucleus (XII) was substituted for the phenyl group, the activity was increased about forty times. Having found the naphthyl compound so active, Madinaveitia compared the activities among themselves, of four other derivatives (XIII-XVI).



He found that the introduction of the hydroxyl group para to the side chain (XIV) greatly increased the activity and that etherification of the phenolic hydroxyl (XV) greatly reduced the intensity, the ketone (XIII) being much less active than the methyl ether of the corresponding alcohol (XVI).

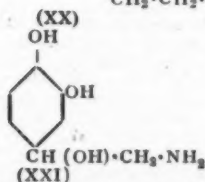
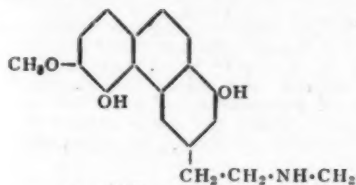
Although considerable time has passed since the isomeric naphthyl-ethylamines (XVII and XVIII) have been synthesised,<sup>24</sup> their sympathomimetic potentialities do not appear to have been explored. 4-Hydroxy naphthyl-ethylamine (XIX), the tyramine analogue of the naphthalene series, was synthesised by Windaus<sup>25</sup>



but, surprisingly and apparently in conflict with the findings of Madinaveitia, it possesses only a slight activity.

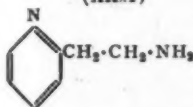
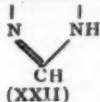
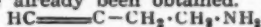
Since the work reported by Rajagopalan on the synthetical aspects of sympathomimetics derived from naphthalene<sup>26</sup> and their pharmacological examination, Day and his collaborators<sup>27</sup> have reported the synthesis of a few derivatives of naphthyl aminoethane but presented no pharmacological data on these compounds.

Hildebrandt<sup>28</sup> reported that thebaine (XX), a derivative of  $\beta$ -phenanthril-ethylamine, has a general reaction towards rabbits like that of 3:4-dihydroxy phenyl ethanolamine (XXI):-

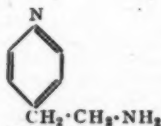


Recently, a small number of ethanamine derivatives of phenanthrene, as also that of dibenzofuran, have been revealed but these compounds were examined only for their analgesic activities.<sup>29</sup>

Ever since the demonstration of the remarkable physiological effects, particularly on blood pressure and the uterine muscle, of histamine<sup>30</sup> (XXII), isolated<sup>31</sup> from ergot of rye and later synthesised by Pyman,<sup>32</sup> it has been considered desirable to prepare similar compounds possessing the ethanamine chain linked to heterocyclic rings other than iminazole. Several such bases have already been obtained.



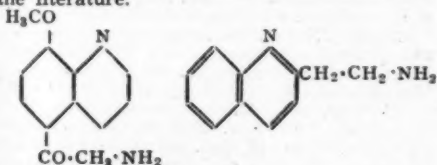
(XXIII)



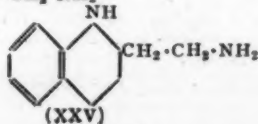
(XXIV)

Of the  $\beta$ -2-, and  $\beta$ -4-pyridyl ethanamines synthesised<sup>33</sup> with the object of ascertaining their suspected activity, it has been found<sup>34</sup> that, whereas the  $\beta$ -2-derivative (XXIII) did not behave like adrenaline but rather like histamine, the  $\beta$ -4-isomer, (XXIV) produced a pressor response similar to but weaker than that of adrenaline.

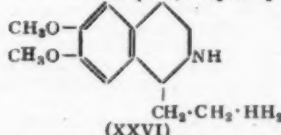
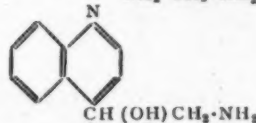
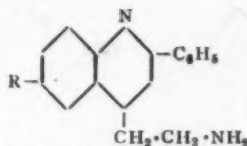
A set of ethanamine derivatives of quinoline and isoquinoline have already been described<sup>35</sup> in the literature.



(XXV)



(XXVI)

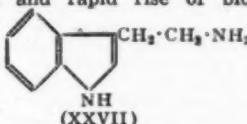


(XXIX)

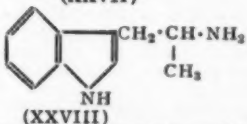
(R = H or OCH<sub>3</sub>)

Quinolinyl ethanamine (XXVI) was found to act on the blood pressure as does phenyl ethanamine, whereas  $\beta$ -2-quinolyl ethanamine (XXV) possesses an activity one-hundredth of that of adrenaline.<sup>36</sup> The remaining compounds in this series do not appear to have been so far tested.

$\beta$ -Indolyl-ethanamine (XXVII) was found<sup>37</sup> to dilate the pupil markedly and produce a substantial and rapid rise of blood pressure



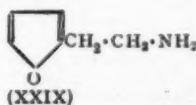
(XXVII)



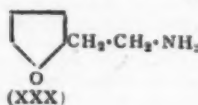
(XXVIII)

while the  $\alpha$ -methyl derivative of indolyl-ethanamine (XXVIII) produced<sup>38</sup> a rise in blood pressure by vaso-constriction, contracted the uterus and stimulated intestinal movements.

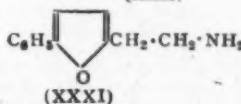
Windaus and Dalmer<sup>39</sup> found that furyl ethanamine (XXIX) produced only a short-lived fall in blood pressure and that its tetrahydro derivative (XXX) was without any effect.



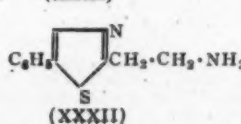
(XXIX)



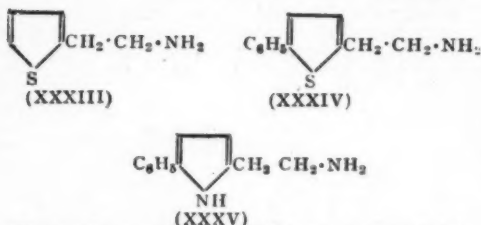
(XXX)



(XXXI)



(XXXII)



Hinegardner and Johnson<sup>40</sup> have prepared thiazole bridges of adrenaline- and tyramine-like bodies (XXXII) which they reported possessed pharmacological interest. Thienyl ethylamine (XXXIII) was found<sup>41</sup> to be as active as the phenyl analogue,  $\beta$ -(5-phenyl-) furyl-ethylamine (XXXI), and analogous derivatives of thiophene (XXXIV) and pyrrole<sup>42</sup> (XXXV) were found<sup>43</sup> to be pressor-active. Thienyl and furyl-isopropylamines have recently been stated<sup>44</sup> to be similar in their action to phenyl isopropylamine.

The investigations in the field of the sympathomimetics, correlating chemical constitution with physiological activity, have been of considerable interest. They alone, more than similar studies in other groups of medicinal compounds, have so far lent themselves to almost rigorous interpretation and made possible the theoretical prediction of the physiological properties of a related member of the sympathomimetic group based on previous knowledge of its chemical structure. Instances of a large measure of actual experimental realisation of many such predictions concerning sympathomimetic action are rather plentiful. As such, these investigations, despite their restriction mostly to members of the benzene series and their regrettable lack of thoroughness as far as the other ring-systems are concerned, may be considered as a triumphant chapter in modern iatro-chemistry.

The comparative studies of the substituted as well as the unsubstituted  $\beta$ -phenyl-ethylamines, and  $\beta$ -phenyl-ethanolamines and their structural allies have brought to light many interesting generalisations. These have given an insight into the subtle ways in which physiological activity can be altered by even slight structural modifications of the sympathomimetics. In the present state of knowledge an answer to the interesting question of whether or not the same or similar rules governing the intimate relationship between constitution and activity of the benzenoid sympathomimetics operate in the case of their analogues derived from the higher polycyclics and the heterocyclics is, however, not yet possible. Another question which naturally arises, namely, whether the knowledge already gained can be applied for the rational evolution of future sympathomimetics possessing ring-systems other than benzene, must also for the present remain unanswered. This is in a large measure due on the one hand to the reason that sufficiently varied and comparable types of compounds belonging to the other ring-systems are not known and on the other, to the fact that, so far no systematic correlation has been attempted with even those compounds that have been available.

The gaps in existing knowledge must be finally bridged before the problem of the rational evolution of future sympathomimetics

belonging to ring-systems other than benzene could be solved. Recent works in this line consist in attempts<sup>20,45</sup> to study systematically the synthesis and biological examination of groups of compounds derived from the carbonyl and hetero-cyclics and which possess the requisite structures necessary for sympathomimetic activity.

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## THE CHEMISTRY, PHARMACOLOGY AND THERAPEUTICS OF THE SULPHONAMIDES\*

DR. V. R. KANOLKAR who presided over the symposium declared that the idea of using chemical substances for treating diseases is not new. The ancient Indian physicians employed oxides prepared from metals according to an elaborate ritual. Towards the commencement of the 16th century, Paracelsus advocated the use of chemical substances of known composition and his statement "All things are poison and nothing is without poison, but the dosage it is, which makes a thing poison" is worth reflecting upon even now. Physicians and pharmacologists have been searching for substances which would show a greater affinity for disease-producing micro-organisms than to the vital tissues of patients when introduced into the body. It was expected that substances which kill pure cultures of micro-organisms *in vitro* may as well dis-infect the blood or other fluids when administered in non-toxic doses. It was soon discovered, however, that small doses of most bactericidal drugs were rendered inert by blood proteins before they can act on the micro-organisms. It is true that remedies have been empirically discovered for some parasitic diseases, such as quinine for malaria, emetine for amebiasis and mercury for syphilis.

The modern methods of chemotherapy may be assumed to have started about 1895 with the use of cacodylates and atoxyl for combating parasitic infections. High hopes of a discovery of specific antiseptic remedies in the early years of this century were entertained when Ehrlich discovered considerable difference in the affinity of different tissues to certain synthetic dyes. Ehrlich and his pupils devoted many years of work in search of a "therapia sterilisans" and their efforts were attended with some success in the synthesis of an organic arsenical compound—salvarsan. Unfortunately most of the drugs synthesised during the first two decades of this century were ineffective against bacteria and viruses though they were potent against protozoa and spirochaetes. The discovery by Domagk in 1935 of a synthetic azo dye which is a powerful agent in arresting the growth of micro-organisms in the tissues has opened up a new era of therapeutic progress. A large number of synthetic compounds have recently been prepared and their pharmacological properties studied in several countries. The progress has been phenomenal, and infections which were looked upon as uniformly fatal have been treated with remarkable success. These drugs have been tried experimentally in animals and clinically in patients in a large number of infective conditions during the last eight years. Their advantages and limitations have been carefully worked out. Their use in plague, a disease more or less endemic in India, has probably been the most

important contribution in this field in our country. Before asking the main speakers to address you, I would like to say a few words about the chemotherapy of plague. The first thing to realise is, that all people who suffer from plague do not die of it. Usually about 50 per cent. survive an attack with almost any treatment. On the other hand, if a fair number of plague bacilli could be cultured from the blood (septicæmic plague) the probability of a fatal termination is certain in nine out of ten cases with most treatments. The efficacy of the sulpha drugs is, therefore, assessed only in septicæmic types of plague.

The use of these drugs is now being extended to the treatment of war wounds and surface inflammations where the drug can be applied in adequate concentration. Dr. Dikshit has prepared a paste which has found favour in the treatment of wounds, burns and tropical ulcers.

DR. K. GANAPATHI said that soon after Domagk's announcement of the therapeutic properties of prontosil, Fournieu and his collaborators made the important discovery that prontosil owed its activity to sulphanilamide produced *in vivo* by reduction. This greatly accelerated the speed of research and engaged a large group of investigators all over the world. The derivatives of sulphanilamide synthesised and studied in large number are mainly of two groups—those substituted at the amino radical and those with substituents at the sulphonamide radical. As a result of the studies, it emerges that only those compounds with a free amino group or in case the amino group is substituted those in which the compound with the free amino group is liberated *in vivo* by fission, show therapeutic activity; in recent years, compounds of this second group like succinylsulphathiazole, phthaloylsulphathiazole have been deliberately prepared to restrict the locus of action of these compounds and make them adaptable for the treatment of intestinal infections. A large number of compounds with various types of substituents at the sulphonamide radical of sulphanilamide have been studied of which the most promising are the heterocyclic derivatives. Starting from sulphapyridine, a rapid search for more active compounds among the heterocycles has presented us the potent drugs as sulphathiazole, sulphadiazine, sulphapyrazine and some of their derivatives. The ring systems known to the chemist and are amenable to the synthetic processes have been tried and most of the compounds obtained thus are either devoid of activity or greatly reduced in activity. Also, substitution of further atoms or radicals in the heterocyclic ring of sulphapyridine, sulphathiazole and sulphadiazine have been tried and the compounds have been found to be varied in activity. The results obtained appear *prima facie* to follow no law from the structural point of view; they lead to the conclusion that the attempts to link the therapeutic activity with a particular structure, picturing the various radicals or atoms to be contributing additively to the therapeutic property of the compound, will not lead us far. Rather it appears that the chemotherapeutic property is more systematically related to some fundamental physical or phy-

\* Abstract of a symposium held on the 27th December at Poona under the joint auspices of the Indian Academy of Sciences, Bangalore, and the National Academy of Sciences, Allahabad.

sico-chemical property of the compound. In the case of the sulphanilamides, wherein we have got a series of compounds of graded activities which differ in structure only in the nature of the substituent at the sulphonamide radical, the problem is only to discover the particular physical property of the compound (governed by the sulphonamide grouping) running parallel to the bacteriostatic activity. Bell and Roblin, concerning themselves with the  $N^1$ -substituted compounds, have succeeded in correlating the dissociation constant with the bacteriostatic action of the compounds against *B. coli* *in vitro* over a fairly wide range. These results are obtained on the basis of the theory (which is derived from Fildes-Woods concept of the mechanism of action of the sulphonamides) that the greater the negativity of the sulphone grouping in the compound, the greater the bacteriostatic activity. This negative nature of the sulphone group appears to be fundamentally related to the activity in some way as yet not perfectly understood and it holds good in spite of the theories of Fildes and Woods being seriously questioned. The problem now consists in quantitatively equating this with some measurable physical property, also among compounds which fall outside the scope of the Bell-Roblin theory.

Dr. B. B. DIXSHIT classified the sulphonamides into three main groups:—(i) those which are readily absorbed from the gastro-intestinal tract, (ii) those which are poorly absorbed and (iii) those which can be profitably used for local application, e.g., to ulcers and wounds; this group consists of drugs of groups (i) and (ii). Important drugs belonging to the first group are sulphanilamide and its pyridine, thiazole and pyrimidine derivatives, the pharmacological actions of which are well known. Important drugs belonging to the second group are sulphaguanidine, succinylsulphathiazole and phthalylsulphathiazole. They are poorly absorbed from the gastro-intestinal tract and thus remain in the intestines producing a bacteriostatic action.

In this country intestinal infections like cholera, enteric fevers and dysenteries are more common than in America and European countries and, therefore, it is highly desirable that research workers should devote their attention towards drugs belonging to the second group mentioned above. From the pharmacological point of view the requirements of such drugs would be that they should not be readily absorbed, they should be soluble to a certain extent in the intestinal juices and they should have a bacteriostatic action on the pathogenic organisms in the intensities like those producing cholera and dysentery. My colleague, Dr. H. S. Mahal, working in my laboratory, has combined sulphonamides with several other known antiseptics with the view that in the intestines their combinations will split up and the individual drugs so liberated will be able to produce their antiseptic action on the intestinal flora. In such experiments if the splitting of the combinations is too rapid, absorption of the individual drugs will also be rapid and if the splitting is too slow, sufficient quantities of the drug to produce the bacteriostatic properties will not be liberated. An ideal drug will be such that it would produce a desired concen-

tration in the intestines without undergoing rapid absorption. We have tried several such combinations but so far as we have not been able to find the ideal drug; we are, however, hopeful of obtaining good results.

The idea of combining antiseptics with sulphonamides, however, appears more promising in the treatment of wounds and ulcers. In fact, here, one need not restrict oneself to sulphonamides. Any combination of antiseptics which will gradually split up in the wound or ulcer could be useful. Such combinations if properly made would not be quickly absorbed from the site of application, would be less irritating and because of slow splitting will be able to exert a continuous antiseptic action. One such combination of proflavin and formalin made by Dr. Mahal has been found to be very useful in the treatment of Tropical ulcers. Because of small stock of the drug at our disposal we could not give it an extensive trial. I have referred to these experiments to draw the attention of research workers to this idea so that better and more powerful antiseptics may be found.

Dr. P. M. WAGLE discussed the therapeutic value of the various sulphonamides in different bacterial infections. After the discovery of the remarkable therapeutic properties of sulphathiazole and sulphapyridine, in experimental plague infections in mice by Sokhey and Dikshit, clinical trials were given to these drugs. Later on sulphadiazine was also tried. These were done in plague epidemics in different parts of India and the results obtained have fulfilled the expectations of the animal experiments. On the whole, including the last trial at Poona, 996 cases have been treated systematically and under strictly controlled conditions. No selection of cases were made but treatment was given in strict rotation as they came. Bacteriological diagnosis was made in each case for plague by isolating the organism and also by determining the presence or absence of septicaemia. The concentration of the drug in the blood after its administration was determined every day in all cases; this was to check up the absorption of the drug and to control the dosage. The haemoglobin estimation, leucocytic count and the differential count were made in all cases every alternate day to control the toxic reaction. Usual precautions in the treatment with the sulphonamides were taken. The concentration of the drugs in the blood aimed at and attained was 5-10 mg. per 100 c.c. of blood in the case of sulphapyridine and sulphathiazole and 10 to 15 mg. in the case of sulphadiazine. Concentrations higher than these were tried; they were not found to give better results but only proved to be more toxic. The actual dosages of the drugs which gave rise to the above-mentioned blood concentrations are as follows:—In the case of sulphapyridine, 2 gms. on admission, 2 gms. four hours later and then 1 gm. every four hours making a total of 8.0 gms. on the first day and then 0.5 to 0.7 gm. every four hours making up 3.0 to 4.5 gms. per day thereafter. In the case of sulphathiazole, 2.0 gms. on admission, 2.0 gms. after four hours and then 1.5 gms. every four hours making up a total of 10.0 gms. on the first day and then 1 gm. every four hours on the subsequent days with a total of 6.0 gms. per day. In the case

Treatment	All cases taken together			Septicaemic cases alone		
	No. of cases treated	No. of deaths	% case mortality	No. of cases treated	No. of deaths	% case mortality
Antiplague serum .. ..	157	37	23.5	71	36	50.7
Sulphapyridine .. ..	122	33	27.0	62	31	50.0
Sulphathiazole .. ..	305	64	20.9	132	55	41.6
Sulphathiazole + antiplague serum	60	12	20.0	25	8	32.0
Sulphadiazine .. ..	81	10	12.3	43	9	20.9
Controls (iodine intravenously) ..	149	80	53.6	75	68	91.0

of sulphadiazine, 2.0 gms. of the sodium salt was given intravenously and also 2.0 gms. of the drug was given by mouth on admission, 2.0 gms. after four hours and then 1 gm. every four hours with a total of 10.0 gms. on the first day and then 1 gm. every four hours on the subsequent days. The results obtained are given in the table. In this, 112 cases have been excluded as they were moribund on admission and the drug has not the chance to act on these drugs. In the table the results are taken (i) taking all the cases and then, (ii) taking only the septicaemic cases and the significance of the results is obvious.

The results show that the sulphonamides possess very striking therapeutic activity against plague infection and have brought about a considerable reduction in mortality. Though the number of cases treated with sulphadiazine is not great as with others, there is a suggestion that it gives the best results. The toxic symptoms observed were as usually described but were less frequent possibly because the dosage and the blood concentrations have been carefully regulated. Sulphadiazine appears to be the least toxic.

Dr. V. L. DESHPONDE gave his experiences of treating plague at Poona before the advent of the sulphonamides and with sulphathiazole and sulphadiazine. The trial with the sulphonamides in plague in the recent epidemic was carried out in collaboration with Dr. P. M. Wagle. The use of the sulphonamide drugs, he said, has brought about a striking reduction in mortality. He dealt at length with many clinical details and observations he had made in his recent trials at Poona.

## PHARMACY AND DRUG LEGISLATION IN INDIA

TWO symposia, one on "Newer Pharmaceuticals" and the other on "Future Pharmacy and Drug Legislation in India", were among the proceedings of the Fifth All-India Pharmaceutical Conference held in Bombay under the presidency of Dr. H. K. Sen during the 21st-23rd December 1944. The first of these covered a wide ground, illustrating some of the recent spectacular achievements of chemistry in its application to medicine. Foremost among these has been our knowledge of the synthetic drugs where development has been along three main lines:—(1) the reproduction, in the laboratory, of products obtained from nature, e.g., adrenaline, the vita-

mins and hormones; (2) discovery of drugs equivalent to, or even better than, those obtained from natural sources, e.g., atabrin, plasmoquine, stilboestrol; and (3) discovery of drugs of entirely new structures, e.g., the sulphanilamides, aromatic amidines, etc. Dr. K. Ganapathi gave a comprehensive summary of these synthetics and dwelt at some length on the sulphanilamides which group has been steadily increasing to our advantage and which has testified to the ingenuity of the organic chemist who, in the words of the lecturer, "has very nearly exhausted the ring systems he can think of". Among the drugs of this group that have recently emerged out of his efforts are some highly potent ones in the treatment of many types of streptococcal, staphylococcal, gas gangrene and intestinal infections. One of these, marfanil, is not nullified in its therapeutic effect, by *p*-amino benzoic acid or pus or tissue decomposition products and is, in this respect, next only to penicillin. Compounds of similar groups are now being studied and offer great promise, particularly in the treatment of local infections where sulphanilamides are not ideal for use.

Dr. B. K. NANDI gave an account of the principal glandular products that have until now earned conspicuous reputation and have met with the clinician's approval. One wished that he had dwelt more on the scope for their manufacture from the slaughterhouse wastes in the country and the need for appropriate municipal and State aid for the proper collection of glands under conditions ideally suited for their subsequent processing.

In a paper on the vitamins, which evoked some interesting discussion, Dr. V. N. PATWARDHAN briefly surveyed the position which these occupy among the pharmaceuticals and indicated how, as a result of the enormous amount of work now in progress, vitamin therapy may, within the next few years, assume a much wider scope than at present. He, however, sounded a note of warning against the indiscriminate use, in the form of shotgun therapy, of the vitamins by the busy practitioner who is only faintly acquainted with the modern advances of vitamin research but is greatly influenced by the manufacturer who swamps him with pamphlets and reports under the respectable name of literature extolling the properties of his particular brand of vitamin preparation. Dealing with the scope and value of vitamins, vitamin concentrates and multivalent vitamin preparations in post-war relief programmes, he stressed on the



need for research on the synergetic or antagonistic action, as the case may be, of one vitamin on another. More information is obviously needed to put the practice of combining more than one vitamin in a single preparation on a sound theoretical basis.

LT.-COL. SOKHEY, who presided over these deliberations, correctly pointed out how manufactures in the country had not availed themselves of the opportunities afforded by the war and had resorted to mere compounding, mostly out of imported pharmaceuticals. Doubtless, there are difficulties in the way of the development of a synthetic drug industry in the country, chief among them being, as mentioned by Dr. R. D. Desai, the need for dependence on foreign imports for a variety of intermediates which cannot be manufactured in the country until the heavy chemical and coal-tar industries get securely established. In this connection, an aspect of drug production that came for little discussion related to bio-synthesis from agricultural and industrial waste products. A host of substances of therapeutic value, like lactic, citric and gluconic acids, food yeast and antibiotic mould metabolites could well be prepared by fermentation processes without dependence upon imported intermediates.

There was unanimity underlying the discussions on the second symposium on the future of pharmacy in the country. The speakers stressed on the need for (1) control of pharmaceutical practice by limiting it to a properly qualified group of people as in most parts of the world, and (2) a uniform central legislation for drugs and pharmacy combined. In opening the discussion, DR. B. MUKERJI referred to the present deplorable position of the profession of pharmacy in India and emphasized how there can be no practice of pharmacy without the aid of medicine and how both the professions should, therefore, work hand in hand and strive together to achieve the goal of a higher standard of national health and fitness.

DR. R. R. NANJI gave a brief review of the growth and development of pharmaceutical education in England and other countries abroad and showed how India was probably a century behind most civilised countries in this respect. He also outlined certain legislative measures aiming at improvements in the standard of training and qualifications of pharmacists and suggested the creation of a Central Pharmacy Board for the general control of the profession.

The Central Government have recently enacted a Drug Act, 1940, and are shortly proposing to enact Drug Rules under this Act, which take cognisance of the urgent needs of the country outlined above. These are happy auguries, for, statutory control over what is at present only a chaotic situation is bound to raise the status and prestige of Indian Pharmacy and bring in its wake a better economic position for the pharmacist and a lasting recognition as an active partner of the noble public health profession. A detailed account of the proceedings of the Conference will appear as a Special Number of the *Indian Journal of Pharmacy*.  
A. SREENTIVASAN.

## SUBSTANTIVITY OF DYES IN RELATION TO CHEMICAL CONSTITUTION\*

SUBSTANTIVITY is not an absolute property and it is difficult to define. There is no sharp demarcation between substantive and unsubstantive dyes. All direct dyes tend to form colloidal solutions. Particles in molecular solution diffuse through the fibre and do not function in the dyeing process, unless there is a change in their state of aggregation due to an alteration in conditions.

There are a few natural colouring matters (bixin, carthamin, curcumin), which are substantive to cotton, and which do not contain nitrogen or sulphur; but the synthetic direct cotton colours are the sodium salts of aromatic sulphonic acids containing nitrogenous groups. Cotton takes up these dyes in the form of neutral sulphonates. Further, marked substantivity to cotton is shown by the leuco compounds of sulphur dyes and of the anthraquinonoid vat dyes, including those not containing nitrogen and sulphur, and the arylamides of hydroxynaphthoic acid.

The structural features favourable to substantivity in azo dyes are now well recognised. Following Schirm's hypothesis of conjugated unsaturation, Hodgson has postulated a coplanar configuration of the aromatic nuclei as a necessary condition for the production of substantivity. Coplanarity in a dye molecule is an advantage for attachment to the cellulose chain, but there are at least two recorded instances of non-coplanar dyes with substantivity for cotton. Sen and Sadasivam noticed that the dye from tetrazotised 2:2'-di-hydroxy-methyl-benzidine and  $\beta$ -naphthol-6-sulphonic acid was substantive. The significant factor here is probably the hydroxyl in each of the groups in the 2:2'-positions; the hydroxyls could anchor themselves by hydrogen bonding to the glycosidic oxygens in suitably situated chains of the cellulose macro-molecule, so that a complicated, but easily conceivable, molecular network between dye and cellulose develops. The second example is a new class of substantive azo dyes described by Allen and Pingert (1944), which are derived from 4:4'-diamino-o-terphenyl and which cannot be coplanar.

Among similar groups of dyes, the substantivity increases from the benzene to the naphthalene, anthracene and the more complex, condensed polynuclear aromatic hydrocarbon series. This is not due to the mere increase in molecular weight, but the special characteristics of the valence-bond structures are involved. The leuco compounds of the anthraquinonoid vat colours as a class are characterised by high substantivity. The leuco compounds, for instance, of dibenzanthrone, its 16:17-dimethoxy derivative and isodibenzanthrone are very highly substantive; and the complete absence of nitrogen and sulphur, invariable constituents of the direct cotton colours, will be noticed. The alkaline solutions of the reduc-

\* Abstract of Dr. K. Venkatraman's Presidential Address to the Section of Chemistry, Indian Science Congress, Nagpur, 1945.



tion products (or 'vats') of some of the anthraquinone vat dyes have such high affinity for cotton, and the baths are so rapidly exhausted, that the dyeing process has to be retarded and controlled by the addition of restraining and level dyeing agents, consisting of glue or synthetic protective colloids.

The substantivity of the anthraquinonoid vats is associated with the resonance among numerous valence-bond structures by which the higher condensed ring systems can be represented. The angular ring systems have a larger number of stable resonating structures and a larger resonance energy than the corresponding linear ring systems. Angular configuration of condensed ring systems is a common feature of anthraquinone vat dyes. Among the isomeric dihydro-anthraquinone-azines, the commercial product which possesses the substantivity necessary for practical dyeing is indanthrone, having the bis-angular orientation. Other examples are the bis-acridone, Indanthrene Violet BN and the tetra-carbazole, Indanthrene Khaki GG. The more complex the polynuclear system and the greater the number of benzene rings, the larger will be the resonance energy. One effect of resonance will be coplanar configuration of the molecules. It would appear that there is a broad correlation between the number of stable resonance forms and the resonance energy on the one hand, and the substantivity on the other, of the leuco compounds of anthraquinone vat dyes.

The older conceptions of substantive dyes as those possessing long thread-like molecules of approximately straight line form, which were based on the benzidine type of azo dyes, must be modified in view of the constitution of the highly substantive leuco compounds of the anthraquinone vat dyes. The affinity of a complex polynuclear dye such as Indanthrene Khaki GG probably involves the attachment of the dye molecules to several parallel cellulose units at suitable points, so that the dye molecules act as bridges or grids in a three-dimensional network.

While the indigoid and thioindigoid vats are yellow, the anthraquinone vat dyes give intensely coloured vats; Indanthrene Yellow G thus gives a deep blue vat. Alkaline reduction of an anthraquinone vat dye produces auxochromic hydroxyl groups which introduce much greater possibilities of resonance than in the case of leuco-indigoids, on account of the large number of aromatic ring systems. Bathochromic effect and substantivity do not always go together, but there seems to be enough evidence to believe that the resonance factors favourable for intense colour are also favourable for substantivity in the anthraquinone vats, the requirements regarding the degree of dispersity in aqueous solution being satisfied.

The conversion of the leuco-forms of vat dyes to the sulphuric esters, the sodium salts of which are marketed as Indigosols and Soledons, greatly reduces the substantivity. The Soledon has a much lower substantivity than the alkaline vat. The reduction in substantivity may be correlated with the change in the colloidal and electrochemical character of the solution, as well as the restraining influence of the sulphonic group on the resonance of the molecule. Among the Indigosols and Soledons, the anthraquinone derivatives have in general higher substantivity than the indigo and thioindigo derivatives, and in the former group

the substantivities run roughly parallel with those of the vats of the parent-dyes.

Schirm has attributed the substantivity of Naphtol AS to conjugation due to enolisation of the -CONH- group, but the constitutional factor fundamental to the substantivity of the naphthols is the hydroxyl adjacent to the -CONH- group, and this must play a part in the attachment to cellulose. Among the facts to be borne in mind in considering the structural forms of the "naphthols" are the substantivity in alkaline solution with consequent ionisation and the speed with which the "naphthols" couple even with very weakly polarised diazo salts, indicating the anionoid character of the 1-carbon atom. Several valence-bond structures may then be suggested as the predominating resonance forms. The essentiality of the 2-hydroxy-3-carboxamide grouping and the nonsubstantivity of the isomers are probably concerned with steric factors governing the attachment of the reactive centres in the naphthol to the cellulose chain. Such steric factors are apparently also involved in the greater substantivity of the  $\beta$ -naphthylamide of hydroxynaphthoic acid in comparison with the  $\alpha$ -isomer. The increase in substantivity by replacing the naphthalene nucleus in the acid half or the benzene nucleus in the amine half of the Naphtol AS molecule by more complex and condensed ring systems is related to the resonance among more numerous valence-bond structures and the larger resonance energy.

The constitutional factors which are favourable to the substantivity of dyes towards cellulose are summarised as (a) conjugated unsaturation; (b) coplanarity of the ring systems; (c) condensed ring systems, representing a large number of resonating forms and high resonance energy; (d) heterocyclic nuclei; (e) specific atoms and groups in suitable positions; (f) dipole characteristics; polar groups of opposite character connected by a conjugated system, leading to a large amplitude of resonance and a large polarisability; (g) colloidal character in aqueous solution, and a balance between the hydrophobic and hydrophilic parts of the molecule.

Measurement of interatomic distances between the reactive centres in dye molecules in their stable resonance forms, and their relation to the interatomic distances between the reactive centres in the cellulose chain, might ultimately give us a picture of the mode of attachment of dyes to cellulose. Since the cellulose macromolecule contains a very large number of both electron-donor oxygen atoms and electron-acceptor hydroxylic hydrogens, the affinity of cellulose for dyes with high molecular resonance structures, having a large amplitude of resonance and a large polarisability, is not difficult to visualise in general terms. Hydrogen bonding readily suggests itself as the likely mechanism of the intermolecular dye-cellulose attachment in view of the strength of the linkage and the rapidity of dyeing processes. However, there is a long way yet to go before complete theories of the colour of dyes and of their varying degrees of affinity for cellulose can be developed. The constitution of the whole series of substantive dyes must be studied in conjunction with the present view of the structure of cellulose as a network of discrete, crystalline micelles together with amorphous regions of disorderly orientation.

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## FAMILIAL CORRELATIONS OR THE MULTIVARIATE GENERALISATIONS OF THE INTRAClass CORRELATION

THE characters of individuals in a family or a group are influenced by two types of factors (i) the common factors which are characteristic of the group and (ii) the random factors which are independent of the group. The former type causes resemblance among the individuals of a group, while the latter brings about their variation. One of the problems, in the study of heredity, is to measure the strength of group characteristics. If we assume that there are a finite number of group factors effecting the characters of the individuals in a group, then suitable measures may be obtained by studying only a few characters for the individuals in a group. In this note, familial correlations, obtained by the multivariate generalisation of the intraclass correlation, have been introduced as suitable measures of the strength of group characteristics and their sampling distributions have been obtained.

2. Let  $x_{ijm}$  ( $i = 1, 2, \dots, n; j = 1, 2, \dots, k; m = 1, 2, \dots, p$ ) represent the observation on the  $m$ -th character of the  $j$ -th individual in the  $i$ -th family. Following Fisher's technique, we replace the observations on the  $p$  characters of an individual by their linear combination and choose the compounding coefficients so as to maximise the intraclass correlation coefficient. If we maximise the function  $t^2 = [1 + (k-1)r]/[1-r]$  instead of  $r$ , we get  $t$  as a root of the determinantal equation.

$$|b_{rs} - t^2 w_{rs}| = 0 \quad (2.1)$$

where  $b_{rs} = \sum_j \bar{x}_{i,r} (\bar{x}_{i,s} - \bar{x}_{..s})$

$$w_{rs} = \sum_j \sum_m (x_{ijr} - \bar{x}_{i,r})(x_{ijs} - \bar{x}_{i,s})$$

and  $k \bar{x}_{i,r} = \sum_j x_{ijr}$ , etc.

There are, in general,  $p$  roots  $t_1, t_2, \dots, t_p$  for the determined equation giving rise to  $p$  correlations  $r_1, r_2, \dots, r_p$  which may be called the *familial correlations*. The following results have been obtained.

(a) The familial correlations are invariant under linear transformations of the variates.

(b) There exist familial correlations  $\rho_1, \rho_2, \dots, \rho_p$ , which are constants of the population obtained by employing the above principle to the population at large.

(c) The joint distribution of the familial correlations  $r_1, r_2, \dots, r_p$ , obtained from samples tends to the  $p$  variate independent normal distribution with

$$E(r_i) = \rho_i \text{ and}$$

$$V(r_i) = (1 - \rho_i)(1 + k - 1\rho_i) / \sqrt{\frac{1}{2}nk(k-1)}$$

when the size of the sample ( $n$ ) is increased.

(d) To carry on suitable large-sample tests the following transformations are suggested. Instead of  $r_i$ , we construct the statistic

$$z_i = \frac{1}{2} \log \frac{1 + k - 1r_i}{1 - r_i}$$

whose variance being  $k/2(k-1)(n-2)$  is independent of  $\rho_i$ .

(e) To test whether the familial correlations are simultaneously zero we use the statistic  $\sum z_i^2/V(z_i)$  which is distributed as  $\chi^2$  with  $p$  degrees of freedom in large samples.

(f) The exact sampling distribution of  $t_1^2, t_2^2, \dots, t_p^2$  on the non-null hypothesis involves only  $r_1, r_2, \dots, r_p$  defined by

$$r_i = \frac{1 + (k-1)\rho_i}{1 - \rho_i} \quad (2.2)$$

and is given by

$$\text{const. } A \prod_{i,j=1}^p \frac{c_{ij}}{(r_i^2 + t_j^2)^{\frac{1}{2}}} \prod_{j=1}^p t_j^{n-p-1} \prod_{i=1}^p dt_i \quad (2.3)$$

$$\times \left| \prod_{i,j} (t_i^2 - t_j^2) \right|$$

where  $A = \left[ \sum_{j=1}^p \frac{D_{ij}^2}{(\tau_i^2 + t_j^2)} \right]^{-\frac{1}{2}}$  and  $D_{ij}$  is the coefficient of  $c_{ij}/(\tau_i^2 + t_j^2)^{\frac{1}{2}}$  in the determinant  $|c_{ij}/(\tau_i^2 + t_j^2)|$  and  $c_{ij}$ 's are defined as

$$c_{ij} = 0, \quad c_{ij}^{\frac{2m+1}{2}} = 2^{\frac{2m+1}{2}} \Gamma\left(\frac{2m+1}{2}\right)$$

$$c_{ij}^{\frac{2m+1}{2}} c_{ij'}^{\frac{2n+1}{2}} = 2^{\frac{m+n+1}{2}} \Gamma\left(\frac{2m+1}{2}\right) \times \Gamma\left(\frac{2n+1}{2}\right)$$

where  $i \neq i'$  and  $j \neq j'$

These substitutions are to be made only after expanding out  $A$  and multiplying it with other factor in (2.3). The distribution of  $\tau_1, \tau_2, \dots, \tau_p$  are obtained from (2.3) by making the transformations

$$t_i^2 = \frac{1 + (k-1)r}{1 - r_i} \quad (i = 1, 2, \dots, p) \quad (2.4)$$

(3) It is interesting to observe that the distribution (2.3) is similar to the distribution of the  $p$ -statistics of Roy (1942) on the non-null hypothesis. A fuller discussion of this subject will be attempted in a paper to be published in *Sankhya* shortly.

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Calcutta,

C. RADHA KRISHNA RAO.

November 18, 1944.

1. Roy, S. N., *Sankhyā*, 1942, 6, 16-34.

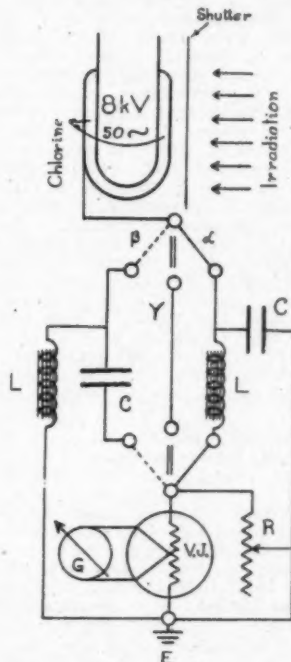
### THE PREFERENTIAL INCIDENCE OF THE LIGHT-EFFECT IN THE HIGH FREQUENCY REGION OF THE DISCHARGE CURRENT

THE apparent variation of the light-effect  $\Delta i$ , with the mode of the measurement of the discharge current  $i$ , was noticed soon after the discovery of this phenomenon.<sup>1</sup> Thus, e.g., when  $i$  was observed with some soft diodes, the light-effect was negligibly small; using triodes, tetrodes, pentodes as also certain metal oxide type rectifiers, the proportionate effect  $\% \Delta i$ , i.e., the current decrease under light expressed as a percentage of  $i$  in the dark, was marked but variable. Usually,  $\% \Delta i$  was greater with a vacuo-junction than an oxide type A.C. indicator.<sup>1</sup> This was traced to limitations in the latter's efficiency of rectification observed *inter alia* under certain conditions of the container surface exposed to the discharge;<sup>1</sup>  $n$ , the frequency of the A.C. supply; and especially the strength and the range of frequencies generated under the discharge; these last are the chief determinant of  $\Delta i$ .<sup>2,3,4</sup>

Fig. 1 shows the main apparatus used for a study of the distribution of light-effect amongst H.F. and L.F., the high and low frequency components of  $i$ . This enters the vacuo-junction (V.J., Fig. 1) via  $\alpha, \beta$  or  $\gamma$ . In  $\alpha$ , the iron core inductance  $L$  admits preferen-

tially L.F. and inhibits H.F.; the latter are bypassed by the capacity  $C$  which comparatively impedes L.F. Similarly,  $\beta$  filters out L.F. and

Fig. 1



admits H.F. In  $\gamma$ ,  $i$  consists of both the L.F. and H.F. characteristic of the discharge.

Table I shows a typical set of results. The ozonised (Fig. 1) filled with chlorine was excited at  $V = 8$  kilo-volts and 50 cycles frequency. The net effect  $\Delta i$  is largest for  $t$ , the

TABLE I

R (ohms)	Circuit	$i$ in dark	$i$ in light	$\Delta i$	$\% \Delta i$
300	$\alpha$ L.F.	2.0	1.23	0.77	39
	$\beta$ H.F.	5.57	3.16	2.41	43
	$\gamma$ H.F. + L.F.	6.78	3.88	2.90	43
1000	$\alpha$ L.F.	4.58	2.65	1.93	42
	$\beta$ H.F.	12.7	6.9	5.8	46
	$\gamma$ H.F. + L.F.	16.4	8.7	7.7	47

unfiltered, i.e., the total discharge current;  $\Delta i$  is sensibly greater for the high than low frequencies. The presence of these frequencies, in addition to  $n$ , and the instantaneous diminution on irradiation of their amplitudes, was observed in the oscillographic studies of this phenomenon.<sup>2,3,4</sup> From the amplitude-changes in the oscillograms,  $\Delta i$  appeared

greater the higher the (output) frequency; the proportionate effect  $\% \Delta i$  was similar at all the frequencies.<sup>3,4</sup> Subsequent work with different types of discharge and of the A.C. detector has shown that (a) both  $\Delta i$  and  $\% \Delta i$  predominate in the H.F.

The decrease of the above quantities by decreasing  $V$  the applied potential is observed over a fairly wide range of conditions.<sup>1,5,7,8</sup> Furthermore,  $\Delta i$  depends upon  $V - V_m$ ,<sup>3,4</sup> where  $V_m$  is the threshold potential required to initiate a discharge;  $V_m$  diminishes by increasing  $n$ .<sup>3</sup> From this it follows that a larger  $n$  would correspond to a lower  $V$ , and therefore, to a reduced light-effect which is actually observed.<sup>3</sup> This combined with (a) suggests that, *ceteris paribus*, the proportion of H.F. in  $i$  would increase by increasing  $V$ ; this is to be expected also on general grounds. That  $V$  is more important than  $i$ , in the present phenomenon, is indicated by its non-observance below  $V_m$ ; secondary ionisation would appear to be a necessary condition.<sup>3</sup> It is to be anticipated, therefore, that despite a large  $i$  obtained, e.g., with a high frequency  $n$  input to the system, the light-effect would not occur at less than the corresponding  $V_m$ . The (preliminary) experimental results are in accord with this deduction.

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Benares Hindu University,  
November 19, 1944.

S. S. JOSHI.

1. Joshi, *Presidential Address, Chem. Sec., Ind. Sci. Cong.*, 1943, 2. —, *B.H.U. Journ.*, 1943, 8, 99. 3. —, *Nature*, 1944, 154, 147. 4. —, *Curr. Sci.*, 1944, 13, 253, 5. —, and Deo, *Nature*, 1944, 153, 434. 6. —, *Trans. Farad. Soc.*, 1927, 23, 227. 7. —, and Deo, *Curr. Sci.*, 1943, 11, 306. 8. —, —, *Nature*, 1943, 151, 561.

### A SCIENTIFIC NEW YEAR'S DAY

JANUARY 1st has struck me, for a long time now, to be the most appropriate day for beginning the year from the scientific or astronomical point of view. This is the time when the earth in its yearly revolution round the Sun in a slightly elliptic path, passes through the perihelion of its orbit and is thus nearest to its progenitor and the giver and sustainer of all life on it.

Any day may be chosen to start the year but there are some which can be said to have a preference over others for this purpose on account of their quasi-uniqueness. These are the days of the equinox or of the solstice. But these days go in pairs and, therefore, there is no absolute uniqueness about them. The time when the earth is in perihelion is unique. There is another time which is also unique, namely, when the earth is in aphelion. But it seems more appropriate to consider the time when the earth is nearest the Sun as the suitable time for the beginning of its revolution than when it is farthest away.

Many people consider that the spring equinox day, i.e., March 21st, would have been a more appropriate day for beginning the year for it is about then that new life for the year may be said to begin. But this day (or any

other day or any other reason) has not the universality that January 1st possesses on account of the earth being in perihelion at about this time. For, if March 21st is spring equinox for the northern hemisphere it is the autumn equinox for the southern hemisphere. Similarly the days of the solstices have the same kind of duality and non-universality.

The Hindu New Year Day, whichever it may be, the 1st of Chaitra on the Lunar reckoning or the 1st of Vaisakh on the Solar, is regarded, of course, by the Hindus as the most appropriate day for beginning the civil year on account of its being round about the spring equinox. But these days are open to the same criticism as above.

If we compare the year with the life of an individual, life begins from small beginnings, grows to maturity and then decays. Life does not begin with even partial maturity. Similarly days begin to grow longer about the 1st January (really on the 23rd December), become longest in June, and gradually dwindle to the smallest on the 22nd December. But this again has a local taint inasmuch as it applies only to the northern hemisphere.

It is perhaps true that when fixing January 1st as the New Year's Day, no reasons of the type mentioned above were taken into account but the day was fixed perhaps on purely religious grounds. However, it must be admitted that it was a very good choice.

It may be mentioned that the time when the earth is in perihelion (or aphelion) is not quite regular. In the first place, the *Nautical Almanac* abandoned from 1927 the practice of giving the hour of the day in this connection as it is given for the equinoxes and solstices. Before then the hour in connection with perihelion and aphelion and even the minutes in connection with the equinoxes and solstices were also given.

In the second place, the day when the earth is in perihelion varies from year to year between January 1st and January 4th, but is never earlier than January 1st. The *Nautical Almanac* of 1921 (N.A.'s from 1914 only are available locally) gives the time of the earth in perihelion to be December 31, 1920, 16 hours. But until 1926 the astronomers began their day at noon instead of, like the civil day, at midnight. According to civil reckoning, astronomer's day, December 31, 1920, 16 hours, becomes January 1, 1921, 4 a.m., and thus the anomaly of having two "perihelion days" in the same year, 1920, disappears. This year, 1945, the perihelion day fell on the 1st January as it did eight years ago, in 1937 and previous to that in 1929 and 1921. This eight-year period, however, is merely fortuitous, for prior to 1921, the earth was in perihelion on January 1st in 1918.

Hence January 1st stands out to have a scientific basis, a uniqueness and a universality with which to start the New Year and which is not possessed by any other day.

Physics Laboratory,  
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Lahore,  
January 8, 1945.

J. B. SETH.



ULTRA-VIOLET BAND SYSTEMS OF  
THE HgI MOLECULE

In continuation of our recent work on the band systems of the diatomic molecules  $\text{HgCl}^1$  and  $\text{HgBr}^2$  a reinvestigation has been made to systematise the analysis and interpretation of the known ultra-violet band systems of  $\text{HgI}$ . Emission bands in the two regions between  $\lambda 3100$ - $\lambda 2800$  and between  $\lambda 2800$ - $\lambda 2650$  designated as systems C and D by Wieland,<sup>3</sup> have been measured and analysed. They form the two components of a  $2\pi \rightarrow 2\Sigma$  electronic transition with the common final  $2\Sigma$  state. The (0,0) bands of the two systems are at  $\nu 32785$  and  $36295$  respectively. The first of these values agrees with that obtained by Wieland, but the second indicates, according to the newly obtained analysis, a shift of the system origin by about  $160 \text{ cm}^{-1}$  towards the violet from that suggested by Wieland<sup>4</sup> as a result of his experiments on the fluorescence of  $\text{HgI}$ . The interval between the components is found as  $3510$ , which is in conformity with the corresponding values of  $3934$  and  $3889$  obtained for  $\text{HgF}^5$  and  $\text{HgCl}^1$  band systems.

The following vibrational constants are determined for the D system obtained in emission

$$\nu_e = 36269.2 \quad \omega_e' = 178.0 \quad x_e' \omega_e' = 1.14 \\ \omega_e'' = 125.7 \quad x_e'' \omega_e'' = 1.10$$

Full details of the analysis will be published elsewhere.

Andhra University,  
Guntur,  
January 18, 1945.

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M. G. SASTRY.  
V. G. KRISHNAMURTY.

1. Rao, K. R. and Ramachandra Rao, *Current Science*, 1944, 13, 279. 2. —, *Ibid.* (in press). 3. Wieland, *Helv. Phys. Acta.*, 1929, 2, 46. 4. —, *Zeits. f. Phys.*, 1932, 76, 801. 5. Howell, *Proc. Roy. Soc. (Lond.)*, 1943, A182, 95.

OESTROGEN POTENCY OF THE  
DEFATTED CASTOR-SEED

It was shown<sup>1</sup> that the oestrogens of the ovary are in combination with a protein and that the complex exhibits feeble lypolytic activity. It was thought of interest to investigate other lipases also. This note deals with the castor seed lipase.

Castor-seeds (*Ricinus communis* Linn.) crushed, and defatted by ether and further powdered to a 40-mesh, was found to possess lypolytic activity (13.4 c.c. of 0.1 N alkali for 0.2 gm. of the material, when tested on olive oil substrate). The material after digestion with papain at  $40^\circ \text{C}$ . (pH 5.0) for 20 hours, with a view to liberate the active principles from the protein complex, was saturated with  $\text{NaCl}$  and thoroughly extracted with ether. Ether is removed by evaporation and the oily residue taken up by olive oil and the solution employed for biological assay.

A group of ten ovariectomised female rats was used. 0.3 c.c. of olive oil solution was injected in each of the ten rats subcutaneously. A few rats were injected with 0.3 c.c. of castor oil to see whether castor-oil has any oestrogen potency. In eight out of the ten nucleated

cells and cornification was observed. The number of leucocytes in the smears was considerably reduced although in no case it was found to disappear completely. Castor oil, however, fails to induce any response.

Thanks are due to Dr. B. K. Bhattacharya for his kind help and to Professor V. Subrahmanyam and Dr. N. N. De for their keen interest.

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Bangalore,  
December 9, 1944.

M. B. SAHASRABUDHE.

*I. Curr. Sci.*, 1945, 14, 43.

## THE CUPRIC-AMMINO SULPHATES

The cupric-ammino sulphates have been studied by a large number of workers. A Bouzat<sup>1</sup> has reported the existence of the penta-, tetra-, and bi-ammino compounds, and he has given the methods of isolation of these. Other workers, H. Rose,<sup>2</sup> D. I. Mendeleef,<sup>3</sup> W. R. Hodgkinson and C. C. Trench,<sup>4</sup> and F. Ephraim,<sup>5</sup> have studied the ammino compounds by various methods.

An attempt has been made in this laboratory to study the cupric ammino sulphates. The method employed consisted in the electrical conductivity measurements of solutions of cupric sulphate, of varying concentrations of ammonium hydroxide, and also of mixtures of the cupric sulphate with varying concentrations of ammonia. It was found that the mixture was much more conducting than either constituent, and the conductivity values were even greater than the sum of the conductivities of the constituents. In a graph the percentage difference between the sum of the conductivities of the constituents and the observed conductivity of the mixture was plotted against the concentration of ammonia. The graph gave a periodic curve with maxima points corresponding to  $2 \text{NH}_3$ ,  $4 \text{NH}_3$ ,  $5 \text{NH}_3$  and  $6 \text{NH}_3$  for a molecule of  $\text{CuSO}_4$ ; showing the existence of bi-, tetra-, penta, and hexa-ammino compounds of cupric sulphate. Thus we observe that the conductivity data not only support the existence of the well-known amines, but also give the evidence of the existence of a new ammino compound, viz., hexa-ammino cupric sulphate which was previously unknown, and has for the first time been recognised in this investigation. Detailed procedure of the study of the hexamine compound will be duly communicated.

The authors offer heartfelt thanks to Dr. S. Ghosh for his kind interest in this work.

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ARUN K. DEY.

Chemical Research Laboratory,  
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December 30, 1944.

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### A PRELIMINARY NOTE ON THE STUDY OF COMPLEX FORMATION BETWEEN STANNIC CHLORIDE AND DIBASIC CARBOXYLIC ACIDS

F. W. CLARKE<sup>1</sup> has observed that the precipitation of stannic sulphide, from solutions of stannic chloride, is hindered by the presence of oxalic acid. Rössing<sup>2</sup> has utilised this fact in separating tin and antimony, by adding oxalic acid to a solution containing a mixture of salts of these, and then passing hydrogen sulphide, when tin remains in solution, and antimony alone is precipitated as sulphide. No definite information is, however, on record as to the cause of the inhibition. The present study has been taken up to investigate the real mechanism and the extent of the inhibition brought about by oxalic acid and other di-basic acids of the group, viz., carbonic, malonic and succinic acids.

Carbonic acid  $\begin{array}{c} \text{C.OOH} \\ | \\ \text{OH} \end{array}$ , the first member of the series and its salt were both unable to act as inhibitors.

It was found that oxalic acid when present in small quantities, had no effect on the precipitation of tin sulphide and it was not until 7 c.c. of N/2 oxalic acid were added to 5 c.c. of M/20 stannic chloride solution that inhibition seemed to commence. With greater amounts of oxalic acid, the precipitate grew gelatinous in nature and became a deep brown gel. Finally when to 5 c.c. of M/20 stannic chloride solution, 10 c.c. of N/2 oxalic acid were added, it became colloidal in nature and exhibited a green fluorescence. There was no point of total inhibition, because on passing sulphuretted hydrogen for a long time or on leaving overnight the colloid jellified and finally settled completely.

Potassium oxalate was found to be a more efficient inhibitor; 7 c.c. of N/2 potassium oxalate were required for 5 c.c. of M/20 stannic chloride as compared to 10 c.c. of oxalic acid.

Malonic acid  $\begin{array}{c} \text{COOH} \\ / \\ \text{CH}_2 \\ \backslash \\ \text{COOH} \end{array}$ , the next higher acid was tried, and a far larger quantity was needed for 5 c.c. of M/20 stannic chloride; sodium malonate was a bit more efficient than the acid.

Succinic acid  $\begin{array}{c} \text{CH}_2\text{COOH} \\ | \\ \text{CH}_2\text{COOH} \end{array}$  was unable to inhibit, though sodium salt was found to have a slight effect.

It is suggested that the inhibition is due to a complex formation between stannic chloride and the acid or salt. Electrical conductivity measurements and absorption spectra studies were also found to support complex formation.

Further work, to elucidate the composition and structure of the complexes, is in progress.

Chemical Research Laboratory,  
Allahabad University. ARUN K. DEY.  
December 20, 1944. A. K. BHATTACHARYA.

1. Clarke, *Chem. News* 21, 124. 2. Rössing, *Zeit. anal. chem.*, 41, 1.

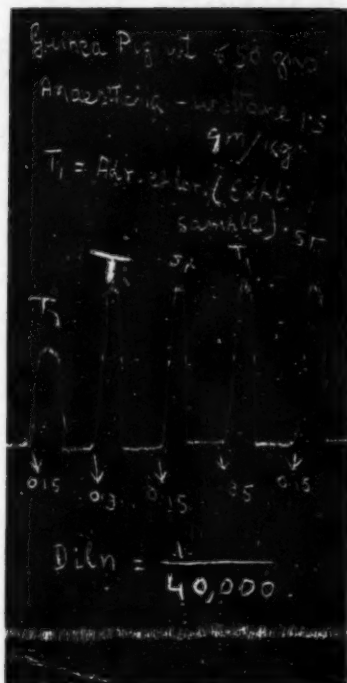
### BIOLOGICAL ESTIMATION OF ADRENALINE IN GUINEAPIGS

BIOLOGICAL assay of Adrenalin solutions is generally carried out on spinal cats according to the method of Elliot. The method is reasonably accurate, and more convenient than the rabbits' intestine method which, though more sensitive, is not adaptable for routine assays. Great difficulty is being experienced in procuring suitable cats; assay trials have revealed that guineapigs could conveniently be used for standardising adrenaline solutions easily available and the method reasonably accurate.

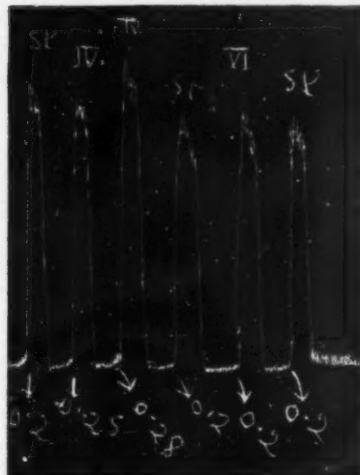
Healthy male or female guineapigs fasting 24 hours and weighing between 500-750 gms. were anaesthetised by intra-peritoneal injection of urethane (1.5 gm. per kg.). Prior to the administration of the anaesthetic the animals were injected subcutaneously with 0.75 mg. per kg. of atropine. The animals were generally ready in 1 to 1½ hour for dissection. If necessary, small quantities of ether were carefully administered. Tracheotomy was done, a fine glass tracheal cannula (prepared in the laboratory) was inserted, tied, and then connected to the artificial respiration pump. Both the external jugular veins were then dissected out, and a venous cannula inserted into one of them. Thereafter the internal carotid artery on both sides was separated very carefully from the vein and the vagus nerve, and ligated at the cerebral end. A fine arterial cannula (prepared and suitably grinded in the laboratory) was then inserted into one of the arteries and connected to the mercury manometer. This part of the operation requires to be done very carefully but provided sufficient care is taken in the selection of the cannula and attaining steadiness of the hands, is not difficult. Occlusion of the artery should be done by traction with a fine thread instead of an artery clip, however small it may be. Rise of blood pressure in guineapig is fairly high at the outset but gradually falls to a level of 25-40 mm. of Hg in about half an hour, when the animal is ready for assay.

Certain precautions should be taken during the preparation of the animal. The operating table should be so raised as to be on a fairly same level with the mercury manometer; otherwise sodium citrate may be sucked into the heart owing to a great difference of pressure and cause the heart to fail. Excursion of the lungs should be carefully regulated by controlling previously the volume of air in the respiration pump. A complete fast of 24 hours is essential for proper anaesthesia; otherwise the animals frequently become resistant.

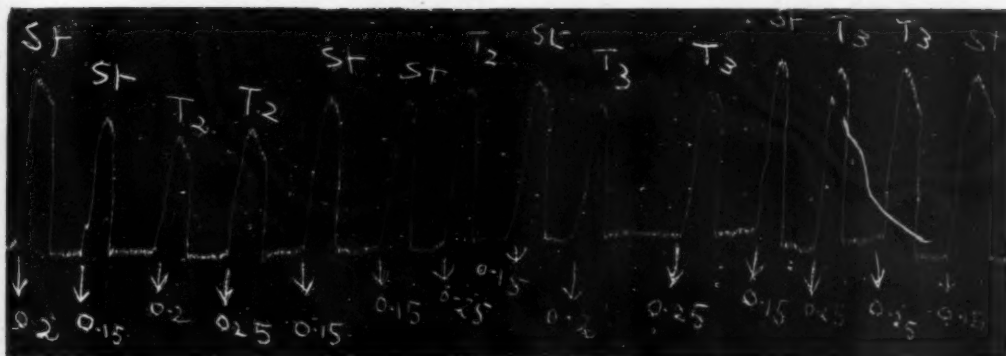
0.1 c.c. of a 1/40,000 dilution gives a fair and rapid rise in blood pressure (30-40 mm. of Hg). The time of rise and fall is almost the same as in spinal cats. We generally assay the test solution in strength of 1/40,000 and the doses are varied from 0.1-0.3 c.c. Infusion of saline given with each test solution is 0.5 c.c. Tachy-phylaxis sometimes occurs, specially if the intervals between the injections are shortened, or a very large number of injections are given.



CURVE I



CURVE II



CURVE III

Curves I, II & III show the response to 1 in 40,000 dilution of Adrenaline

Adult guineapigs are found to be somewhat resistant to anaesthesia. Quick-acting anaesthetics, single or in combination, such as chloroform + urethane, though producing rapid action, are often found to kill the animal during operation, or the period of testing. Chloroform and ether anaesthesia was found to be unsuitable for the purpose.

Preliminary atropinisation of the animal is very helpful in preventing vagal inhibitions during rise in blood pressure, and tended to maintain a fairly constant level.

Accuracy of the method.—Solutions of adrenaline could be standardised by this method with an accuracy of  $\pm 4-10$  per cent. The

results compared well with the results on spinal cats.

Bengal Immunity Research Lab,  
Calcutta,  
December 23, 1944.

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J. K. Ghosh.

### THREE NEW RECORDS OF NEMATODE WORMS FROM PUNJAB AND THE UNITED PROVINCES

In the paper are recorded *Schwartziella nodulosa* (Schwartz, 1928) and *Trichostrongylus colubriformis* from buffaloes and *Capillaria bovis* from buffaloes and goats in Punjab and U.P. Specimens were collected from U.P. in February 1944 from buffaloes slaughtered at Bareilly. *Capillaria bovis* was recovered in August 1944 from two goats received from the General Disease Investigation Section of the Imperial Veterinary Research Institute, Izatnagar. Examination of the intestines of buffalo calves in Punjab was undertaken in October 1944 and in Bareilly it was confined to nodules only.

#### *Schwartziella nodulosa*

As the parasite is economically important its incidence was investigated and in the table are given the numbers found in the nodules as well as those lying free in the intestinal lumen respectively.

#### Number of Parasites

- (a) Embedded in nodules—  
31, 5, 11, 88, 44, 35, 19, 31, 10, 25.  
(b) Free in the lumen—  
69, 48, 18, 51, 90, 52, 50, 89, 22, 65.

At Sialkot all the twenty calves ranging in age from one to two years harboured the parasite. A very large number of adult buffaloes examined at Izatnagar were found to be free from worms.

The parasite was originally described by Schwartz (1928) as *Cooperia nodulosa* from a carabao. Le Roux (1936) and Travassos (1937) transferred the species to their newly created genera *Schwartziella* and *Paracooperia* respectively. Matoff (1938) records the worm from Bulgarian buffaloes and states that it occurs in the nodules in the caecum also. The author has examined a large number of nodules from caecum but has never met the parasite. Instead oesophagostome larvae have always been found.

#### *Capillaria bovis*

The parasites were collected from buffalo calves and goats in small numbers, five being the largest met with in a calf. The parasite has not previously been collected from these animals in this country.

Host—*Capra hircus* and *Bos bubalus*.

Location—Small intestine.

Locality—Izatnagar, U.P.

#### *Trichostrongylus colubriformis*

The parasite was twice collected from calves at Izatnagar. It has not been previously recorded from this animal.

Host—*Bos bubalus*.

Location—Small intestine.

Locality—Izatnagar, U.P.

Military Dehydrated Meat Factory,

Agra;

M. M. SARWAR.

January 1, 1945.

Le Roux, P. L., *Jl. Helm.*, 1938, 14 (2), 113-18.  
Matoff, K., *Helm. Abstracts*, 1938, 7, No. 266. Schwartz,  
B., *Proc. U.S. Nat. Mus.*, 1928 74, Art. 20. Travassos,  
L., *Monograph Do Inst. Oswaldo Cruz.*, 1937, 1, 1-511.

### ACETYLCHOLINE TRANSMISSION AT NERVE ENDINGS

DURING experiments on frog stomach in December 1944 and January 1945, it was noticed that muscles from stomachs of certain frogs were absolutely refractory to the action of acetylcholine (1 in  $10^3$  to 1 in  $10^4$ ), even after treatment with eserine (1 in  $10^7$  to 1 in  $10^4$ ), though they responded normally to alternating current, direct current and potassium. As this seemed anomalous, it was decided to investigate the action of acetylcholine on other tissues, such as the heart and rectus abdominis of the same frogs, the stomach muscles of which were refractory to the action of acetylcholine. The following effects were observed:—

1. *A Natural Atropine Effect.*—The stomach was insensitive to acetylcholine (1 in  $10^3$  to 1 in  $10^4$ ), even after treatment with eserine. The heart was also found refractory even after eserisation. In the former contraction was produced by electric current, and in the latter complete standstill was produced by vagus stimulation. The rectus abdominis was sensitive; so also dog stomach and rabbit gut, thus eliminating any doubt regarding the potency of acetylcholine (B.D.H.) employed.

2. *"Acetylcholine Escape"*.—In these hearts acetylcholine may have a temporary mild inhibitory effect; the muscle, however, soon adapts, and normal beats are restored after four to five contractions in the continued presence of acetylcholine. Before return to the normal the beats are augmented. The recovery is not due to destruction of acetylcholine as shown by the fact, that change of solution has no effect. Further if the muscle has adapted to low concentrations of ethylcholine (1 in  $10^7$ ) higher concentrations (1 in  $10^6$  to 1 in  $10^4$ ) are rendered inert. Inhibition is produced if acetylcholine is alternated with Ringer solution. These results are identical with those found in plain muscle (Singh, 1942). After adaptation to acetylcholine, the vagus stimulation still brings the heart to a standstill.

3. *Augmentation of the Beats.*—Far from producing inhibition, the beats were augmented. The heart may become hyperirritable in high concentrations of acetylcholine (1 in  $10^5$ ), as shown by numerous extra systoles. There may be even contracture as found in plain muscle.

4. *Effect of Initial Length.*—The inhibitory effect of acetylcholine is augmented by increase in initial length of the heart fibres. Acetylcholine which may produce no effect on the heart may produce inhibition, if the latter is distended by increasing the perfusion pressure. These effects are identical with those found in plain muscle, wherein it was found that with increasing length of fibres, not only contraction but also inhibition was enhanced.

In the above experiments, purely mechanical effects may produce identical results, an increase in perfusion pressure may prevent the heart from contracting, and so simulate inhibition. The effects of acetylcholine, therefore, should be controlled by saline only and by the action of atropine. Moderate distension of the heart thus favours excitation as well as inhibition. This is necessary as otherwise when



the excitability is increased, the heart may not relax properly.

5. Acetylcholine in small concentrations potentiates the response to electric current in frog stomach (Singh, 1939). It is possible that chemical transmission potentiates electrical transmission.

Department of Physiology,  
Medical College,  
Hyderabad, Sind,  
January 19, 1945.

INDERJIT SINGH.  
K. B. SEHRA.

Singh, I. J. *Physiol.*, 1939, **96**, 367; *Ind. Journ. Med. Res.*, 1942, **30**, 629.

# A NEW BACTERIAL LEAF-SPOT ON PIPER BETLE

A NEW type of bacterial leaf-spot disease was observed on *bangla* variety of pan (*Piper betle*) at Ramtek during December 1943. So far, under field conditions, the disease has not been observed to occur on *kapuri*, *kakher* and *gangari* varieties. The mode of infection and symptoms of this leaf-spot disease are entirely different from those described by Raghunathan (1926, 1928), Park (1934), Nirula (1931) and Asthana and Mahmud (1944). As far as known to the authors this disease has not so far been reported from anywhere else.

The earliest symptom of the disease is the presence of extremely minute pale-yellow spots either on the lower or upper sides of the leaves. Within a couple of days the initial spots turn dark-purple in colour and are slightly raised. There are no corresponding spots or discolouration on the other side of the leaf. Yellow coloured zones with water-soaked areas are not formed round these spots as in the leaf-spot disease described by Raghunathan (1926). The spots may appear inbetween the veins or on or along the veins. In the former cases they are more or less round or roughly angular while in the latter they are irregularly elongated or branched like fern leaves. They vary considerably in size, measuring from 1 mm. to 1 cm. across, and are generally apparent only on one side of the leaves. In cases where rotting has advanced considerably these spots are visible on both the sides. The infected leaves gradually turn yellow and fall off. The disease has not been observed to cause any damage to roots, stems or petioles.

Healthy leaves of *kapuri* and *bangla* varieties were artificially inoculated by pure cultures of the pathogen. Inoculations were either carried out by spraying the leaves with a suspension of the bacterium in sterile distilled water or simply by smearing the leaves with the pure cultures of the organism. Under both the methods positive results were obtained on either of the varieties. *Kapuri* variety proved as susceptible to the disease as *bangla*. Under moist conditions the symptoms of the disease appeared within 12 to 18 hours. Infection appeared with equal readiness on both the sides of the leaves of all ages. On re-isolation the same pathogen was isolated from all the infected leaves. Inoculations of roots, stems and petioles gave negative results.

Parenchymatous cells are chiefly infected, the pathogen being intra-cellular. In the earlier stages of infection the organism is found only in the epidermal cells but later on it invades spongy and palisade cells. In highly advanced stages of rotting the pathogen is occasionally seen in the phloem and xylem vessels as well, though mostly in the former. The invaded cells slightly enlarge in size, turn dark-lemon and disintegrate. The leaves turn yellow and gradually drop off. Two to three spots are enough to kill a leaf. In some cases the parasite enters the host through the stomata but in others the entry appears to be directly through the epidermal wall. There are no stomata on the upper side of pan leaves of *bangla* and *kapuri* varieties yet the entry of the organism is easily effected by spraying or keeping a small bit of inoculum there. In some cases the organism has been found to enter through the stomata on the underside of the leaves while in others the epidermal cells are clogged but the neighbouring stomata and the cells beneath them are absolutely free of it. All these show that the presence of stomata or wound are not at all essential for the entry of this bacterium into the host cells.

On bouillon-agar plates the organism produces sky-white colonies within 12 to 18 hours which later on turn maize-yellow. The colonies are round, thin and flat, glistening and marked with ridges. In texture they are dry and brittle. The colonies have a distinct central area surrounded by an outer ring and a lobed margin; the lobes occasionally branching out fern-like and appear fan-shaped. On bouillon-agar streak the growth is echinulate in formation but in stab cultures it is filiform.

The pathogens are rod-shaped bacterium, measuring  $1.2 \times 2.5 \mu$  and occur in pairs or in chains of 3 to 12 or even more cells at a time. They are fairly motile both in solid and liquid media and in young and old cultures. Twenty-four to 48 hours-old cultures show very brisk motility of the sinuous swimming type, rarely straight and frequently with spells of quick and sudden tumbling on the short axis. At  $30^{\circ}$  to  $38^{\circ}$  C., the sporulation, even in young cultures, is in abundance. The spores remained viable even when they were heated to  $90^{\circ}$  C. for ten minutes.

The characteristics of the pathogen as described above are quite different from those of *Bacterium betle* Reg. (1926, 1928). It is presumed to be a new species and is provisionally named *Bacillus betle*.

Mycology Section,  
Agricultural Research Institute,  
Nagpur, C.P.,  
November 17, 1944.

R. P. ASTHANA.  
K. A. MAHMUD.

1. Asthana, R. P. and Mahmud, K. A., "Bacterial leaf spot of *Piper betle*". *Ind. Jour. Agri. Sci.*, 1944 (under print).
2. Nirula, R. L., "A bacterial disease of betel vine leaves." *Indian Sci. Congr.*, 1931, **18**, Annual Meeting, Nagpur, 1931. Abstracts of papers—*Section Botany*, p. 5.
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### CLEISTOGAMY IN SOME OF THE FLOWERS OF *CAJANUS INDICUS* L.

CLEISTOGAMY is a common phenomenon among the different families of angiosperms and is chiefly characterised by autogamous type of pollination and seed production. The development of cleistogamic flowers in an otherwise normally developing chasmogamic form due to certain environmental change caused by drought, excess of moisture, shade, surrounding soil, etc., is separately grouped by Uphof<sup>2</sup> as "ecological cleistogamy". The exact edaphic factor concerned in inducing the production of cleistogamous flowers are in many cases difficult to determine.

In the course of the breeding work in *Cajanus indicus*, many cases of cleistogamic tendency was noticed in the majority of the flowers. The flowers of *Cajanus* are considered to become chasmogamic having insect visitors like *Megachile lanata* and *Apis florea*. Examination of the flower buds at various stages indicated that the pollen grains mature early and anthesis takes place 34 hours before the actual opening of the flower. The stigmatic surface gets profusely dusted with the pollen which begin to germinate and form pollen tubes, thus resulting in autogamy. Mehta and Dave<sup>1</sup> also observed a similar condition in their studies in *Cajanus indicus* and state that anthesis takes place at least 24 hours before the opening of the flowers. They do not attribute any significance to this interesting feature. Pollen grains were found to spontaneously germinate soon after anthesis on any surface of the flower such as petal, filaments, etc.; the stimulus of the stigma was not, therefore, necessary for initial germination, a character reminiscent of cleistogamous flowers. This feature is similar to Warming's<sup>3</sup> observation in *Campanula uniflora* from Greenland. In this plant the pollen grains get deposited on the stigmatic surface in the bud condition itself developing pollen tubes and when further pollination is no longer possible the flowers become chasmogamic. In *Cajanus indicus* the author's observations indicate that the percentage of such ecological cleistogamic flowers goes up to 80 per cent. in the months of September to November. The exact edaphic factors responsible for such a feature have not been determined.

Department of Agriculture,  
Bangalore,  
January 10, 1945.

D. M. GOPINATH.

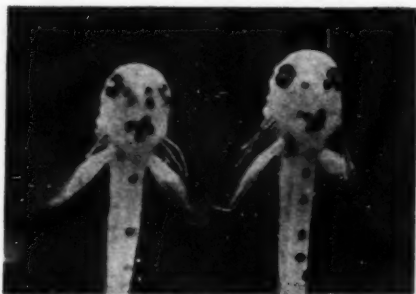
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### ON THE OCCURRENCE OF 'EXTERNAL' GILLS IN THE LOACH—*LEPIDO- CEPHALUS THERMALIS* (C.V.)

TRUE external gills of ectodermal origin occur only in Crossopterygii, Dipnoi and Amphibia. The embryos of elasmobranchs possess long filamentous gill lamellae projecting out of the

gill clefts. Such endodermal gill filaments have been noticed in the larvæ of *Gymnarchus* and *Heterotis* by Budget and Misgurnus by Gotte.

The occurrence of 'external' gill filaments in Teleosts is a rare feature. While studying the early development of the loach—*Lepidocephalus thermalis* (C.V.) it was noticed that the larvæ possessed long gill filaments projecting out of the opercular opening. Second day after hatching the larva was observed to develop a filamentous vascular loop projecting out



5 days old larva of *Lepidocephalus thermalis* (C.V.)  
showing 'external' gill filaments

of the opercular opening. The loop gradually elongated in size. About the fifth day four such filaments were noticed on either side. During the third and the fourth weeks the filaments branched considerably. They were kept in constant movement by the opercular flaps. These filaments were gradually absorbed giving place to normal internal gills between the fourth and the fifth weeks. A microscopical examination of the sections of the head of the larva revealed that the 'external' gill filaments are derived from the endoderm covering the branchial bars.

It is well known that both *Misgurnus* and *Lepidocephalus* perform intestinal respiration taking air directly by the mouth and passing it out of the anus and that they are well adapted for living in muddy waters deficient in oxygen. The development of larval 'external' gills in these two loaches is probably intended to provide a greater respiratory surface to surmount the adverse conditions prevailing in such muddy waters.

Fisheries Section,  
Department of Agriculture,  
Bangalore,  
February 8, 1945.

B. S. BHIMACHAR  
AUGUSTINE DAVE

1. Budget, J. S., *Trans. Zool. Soc.*, 1901, 16, pt. 2.
2. Das, B. K., *Compt. Rend. XII. Congrès Internat. de Zool.* 1935. Graham Kerr, 1919, *Embryology*, Vol. II.

### THE CHROMOSOME NUMBERS IN THE FAMILY ANONACEÆ

THE family Anonaceæ is one of the little known families in respect of its chromosome numbers. In 1936, Locke<sup>1</sup> noted that the haploid number of chromosomes in *Asimina triloba* was probably nine. One of us (R. D. A.), in 1937,

found<sup>2</sup> that the haploid number of chromosomes in *Anona squamosa* and *A. reticulata* was seven. Kumar and Ranadive<sup>3</sup> (1941) also found the same number in meiosis in these two species, as also in the two other species they investigated, namely, *A. cherimoliana* and *A. muricata*.



Very recently the present authors investigated some more members of this family and found that the haploid number of chromosomes was eight in *Artabotrys odoratissimus* and nine in *Polyalthia longifolia*. A study of the somatic divisions in the root-tips revealed that the diploid number of chromosomes is fourteen in *Anona squamosa* and *A. reticulata*, sixteen in *Artabotrys odoratissimus* and eighteen in *Polyalthia longifolia*. This confirmed the haploid number of chromosomes previously noted by us in these plants.

One of us (R.D.A.) wishes to express his best thanks to Prof. S. V. Shevade, Dr. T. S. Mahabale and Prof. V. G. Phatak for their keen interest and help in the work.

Gujarat College, Ahmedabad,  
Wilson College, Bombay,  
January 20, 1945.

J. J. ASANA,  
R. D. ADATIA.

1. Locke, J. F., *Bot. Gaz.*, 1936, **98**, 159-168. 2. A. Thesis submitted to the University of Bombay for the M.Sc. degree in 1937. 3. Kumar and Ranadive *Jour. Bom. Univ.*, 1941, **10**, p. 8.

# ON SOMATIC DIVISION, REDUCTION DIVISION, AUXOSPORE-FORMATION AND SEX DIFFERENTIATION IN *NAVICULA HALOPHILA* (GRUNOW) CLEVE

*Navicula halophila* occurs in good quantity at Madras. The life-history of the Diatom was studied by the author with the help of laboratory cultures. Special attention was devoted to its auxospore-formation and the nuclear details connected with the process.

Somatic division takes place in the usual manner, the chromosomes being arranged in a ring around the spindle at metaphase as is characteristic of Diatoms. The chromosome number appears to be 48-52 (2n). After cytokinesis, two new valves are secreted by the daughter protoplasts inside the old valves.

During auxospore-formation two cells come near each other (Fig. 1) and secrete a common mucilaginous envelope. The nucleus of each cell divides meiotically and forms two nuclei. All the stages of the meiotic division were observed. The haploid number of chromosome appears to be 24-26. The contents of each cell then divides into two protoplasts, each protoplast receiving one haploid nucleus. The haploid nucleus in each daughter-protoplast undergoes the second division and forms two nuclei. Of these two nuclei in each daughter-protoplast, one degenerates and the other remains functional, so that ultimately, each daughter-protoplast (gamete) has one single haploid nucleus. Finally two gametes are organised in each of the conjugating cells (Fig. 4).

The two gametes of one of the cells escape out of the valves and fuse with the two gametes of the other cell. The latter gametes remain passive and do not move out of the parent valves. Both the zygotes are formed in the latter cell (Fig. 5).

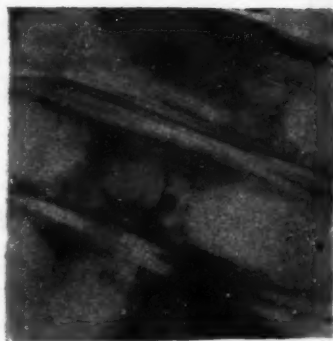
The zygotes (auxospores) germinate after a few hours of rest and form two new Diatom cells (Fig. 6). The two gametic nuclei inside each auxospore do not fuse for a long time and fuse only after the auxospore has reached its full size.

The nuclear details connected with auxospore-formation among the Pennate Diatoms have been recorded only in a few forms (*Cymbella lanceolata*, Geitler 1927 a; *Cocconeis placentula*, Geitler 1927 b; *Nitzschia subtilis*, Geitler 1928; *Synedra ulna*, Geitler 1939; *Rhoicosphenia curvata*, Cholnoky 1927; *Anomoeoneis sculpta*, Cholnoky 1928; *Cymbella cistula*, Cholnoky 1933; and *Gomphonema geminatum*, Meyer 1929). But nothing is known regarding the nuclear details connected with auxospore-formation in the very common genus, *Navicula*, though auxospore-formation has been previously recorded in the genus [*Navicula Grevillei* (Smith 1856); *N. serians* and *N. rhomboides* (Carter 1865); *N. cuspidata* var. *ambigua* and *N. elliptica* (Pfitzer 1871); *N. viridula* and *N. scopulorum*, (Karsten 1896); *N. crucigera* (Karsten 1897); *N. didyma*, *N. ramosissima*, *N. directa*, *N. subtilis* and *N. pygmaea* (Karsten 1899); and *N. seminulum* (Geitler 1932)]. In the present form the author was able to follow all the details of the nuclear changes connected with the auxospore-formation. This appears to be the first complete account of the nuclear changes connected with auxospore-formation in this genus.

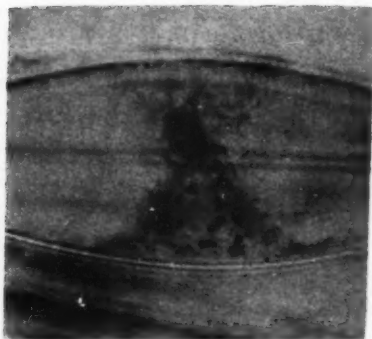
Again, in the Pennate Diatoms, previously, both isogamous conjugation [e.g., *Rhopalodia gibba* (Klebahn 1896); *Epithemia zebra* var. *saxonica* and *Denticula Vanheurckii* (Geitler 1932)] and anisogamous conjugation [e.g., *Cymbella lanceolata* (Geitler 1927 a); *Nitzschia subtilis* (Geitler 1928); *Gomphonema parvulum* var. *micropus* (Geitler 1932)] have been recorded. In the former the gametes of both the cells are equally active and as a result, the two zygotes are formed between the two pairing cells. In the latter type of conjugation, of the two gametes that are formed in each pairing cell, one is active and motile,



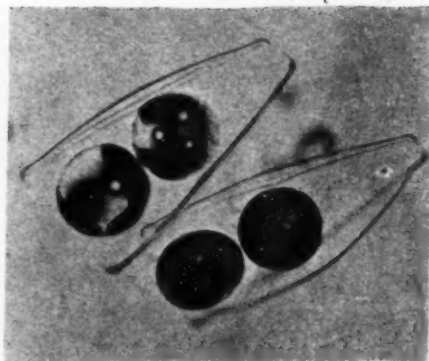
1



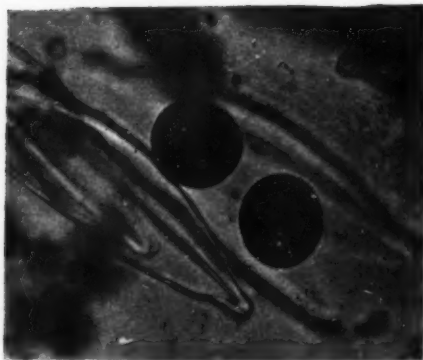
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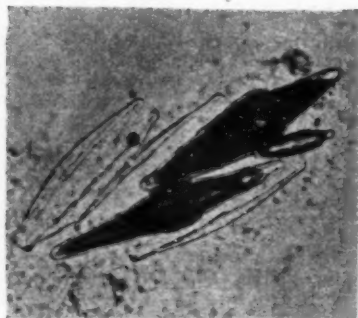
3



4



5



6

*Navicula huiophila* (Grunow) CleveFIG. 1. Two cells just come near each other (living material)  $\times 650$ .FIG. 2. Synizesis  $\times 1500$ .FIG. 3. Diakinesis.  $\times 1500$ .FIG. 4. Two gametes in each one of the pairing cells ready for conjugation (living material)  $\times 500$ .FIG. 5. Two zygotes (auxospores) inside the valves of one of the conjugating cells (female) (living material).  $\times 650$ .FIG. 6. Two zygotes (auxospores) germinating. Note the two auxospores are seen inside the valves of one of the conjugating cells (female).  $\times 350$ .



while the other is passive. During conjugation, the active gamete of one cell passes over to the opposite cell and fuses with its passive gamete and the active gamete of the latter cell behaves in a like manner and fuses with the passive gamete of the former cell. As a result of this a zygote is formed in each of the two conjugating cells. Geitler (1935, page 154) with reference to this phenomenon states that "the physiologically anisogamous behaviour involved in the formation of two gametes permits the interpretation that each mother-cell forms two gametes of opposite sex, a male motile gamete and a female non-motile gamete. The mother-cells themselves may, accordingly, be regarded as hermaphroditic and the entire behaviour would, from this view-point, correspond to that involved in the conjugation of the Ciliates. So far as we know, sex determination occurs phenotypically in all cases hitherto investigated. A sex chromosome mechanism has not been observed nor can it be expected."

In the case of the present Diatom, the conjugation is anisogamous, but, the anisogamy observed here is quite different from those recorded previously among the Pennales. Here, of the two gametes that are formed in each cell, instead of one of them being active and the other passive, both the gametes of one cell are active (i.e., physiologically male), while both the gametes of the other cell are passive (i.e., physiologically female), with the result that both the zygotes are formed in the latter cell, unlike in the previously recorded cases, where a zygote is formed in each of the two cells. The mother-cells in the form under investigation (*Navicula halophila*), therefore, should be regarded as dioecious, i.e., as either male or female and not as monoecious (hermaphroditic) as in the previously recorded cases.

The author wishes to express his indebtedness to Prof. M. O. P. Iyengar, M.A., Ph.D. (Lond.), F.L.S., for his guidance and help throughout the course of this work. His sincere thanks are also due to the authorities of the University of Madras for the award of a research studentship during the tenure of which this investigation was carried out.

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December 11, 1944.

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## HISTIDINE AND TYROSINE IN HÆMOGLOBIN FORMATION

Of the essential amino-acids present in the protein part of hæmoglobin, histidine is quantitatively one of the most important. It was shown to have a hæmatogenic action by Fontes and Thiovolle (1930)<sup>1</sup> in experiments on normal dogs and rabbits. Barrie (1937)<sup>2</sup> found that guinea-pigs gave a reticulocyte response to histidine hydrochloride and attributed this effect to the stimulating action of histidine hydrochloride on gastric secretion and the consequent increase in the production of the hæmopoietic factor effective in pernicious anaemia. Cuthbertson et al. (1931)<sup>3</sup> also consider this amino-acid to have a stimulating action on hæmopoietic tissue. The results of administration of histidine in human anæmias have, however, been generally negative (cf. Cuthbertson, loc. cit., Dominici and Pental, 1931<sup>4</sup> and Tochowiez, 1936<sup>5</sup>).

In our experiments the object of which was to ascertain if this amino-acid provides structural material for the formation of hæmoglobin, the effect of dietary histidine was studied on animals suffering from experimental anaemia.

The experimental procedure was exactly the same as that used with tryptophane (Yeshoda, 1943).<sup>6</sup> Rats, made anæmic by injection of phenylhydrazine, were used. Histidine was removed from hydrolysed casein by silver precipitation (Vickery and Leavenworth, 1928).<sup>7</sup> All animals experimental as well as controls, received 20 mg. of tryptophane to make up for the destruction of tryptophane during acid hydrolysis. The animals in the control group received no histidine, while those in the experimental group were given 50 mg. of histidine hydrochloride daily from the onset of acute anaemia. The results tabulated below show that histidine significantly accelerates the formation of erythrocytes and hæmoglobin. Animals receiving histidine had their cell count and hæmoglobin restored to normal in twelve days on the average, while on a histidine-deficient diet the time of recovery was usually a month.

The effect of histidine differed from that of tryptophane in connection with their mode of action; while with tryptophane the hæmoglobin formation lagged behind the increase in R.B.C. with histidine both cell count and hæmoglobin content were simultaneously normalized.

TABLE I  
Histidine—Average values for R.B.C. and  
haemoglobin

	Histidine group			Histidine deficient group		
	Days		In-crease	Days		In-crease
	0	12	%	0	12	%
R.B.C.	2.99	6.62	121.4	2.99	4.89	63.4
Haemoglobin	7.24	13.89	91.8	7.13	10.30	44.4

TABLE II  
Statistical analysis

No. of animals	Histidine group		Histidine deficient group		$\frac{X - X_2}{\sqrt{e_1^2 + e_2^2}}$
	6		6		
	Mean increase $X_1$	Standard error of mean $e_1$	Mean increase $X_2$	Standard error of mean $e_2$	
R. R. C.	3.63	.1219	1.92	.1581	7.76
Hæmoglobin	6.65	.2247	3.13	.3818	7.95

Similar experiments carried out with tyrosine, the results of which are tabulated below, show that this amino-acid plays no essential role in haemopoiesis.

TABLE III  
Tyrosine—Average values for R.B.C. and  
haemoglobin

	Tyrosine Group			Tyrosine deficient group		
	Days		In-crease	Days		In-crease
	0	12	%	0	12	%
R.B.C.	3.35	6.18	86.1	3.31	6.24	88.5
Haemoglobin	8.06	13.18	63.5	8.14	13.07	60.5

Acknowledgement is made to Prof. M. Damodaran for his interest in the work.

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January 29, 1945.

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## MITOSIS DURING BUDDING IN SACCHAROMYCES CEREVISIAE

THERE is little agreement as to whether during budding the nucleus of *S. cerevisiae* divides by mitosis (Kater,<sup>1</sup> Beams *et al.*,<sup>2</sup> Richards,<sup>3</sup> Henrici<sup>4</sup>). Guilliermond<sup>5</sup> classifies yeasts as haplo- and diplobiontic depending on whether meiosis takes place after or before zygote formation. This is based solely on the assumption that since nuclear reduction occurs in higher Ascomycetes, in yeasts also "meiosis must occur within the ascus". Any advance in our knowledge of the cytogenetics of the yeasts depends on a demonstration first of mitotic division during budding. Badian<sup>6</sup> observed during budding two chromosomes which split longitudinally to give rise to two daughter-nuclei but Guilliermond is disinclined to accept his conclusions. Darlington<sup>7</sup> states that "the effective test of a nucleus is not so much in its chemical and physical properties, but in its behaviour: a nucleus is a cell-body which arises or reproduces by mitosis". Strict application of the above test to yeasts renders doubtful even the identification of a particular structure in the yeast-cell as the nucleus.

Every text-book on Cytology warns the reader of the caution to be exercised in interpreting certain appearances as amitosis. Re-investigations in many cases with improved technique have resulted in demonstration of mitosis in cells which have previously been thought to divide by amitosis and Darlington mentions "that the apparent contradiction to genetic principles in the occurrence of amitosis need no longer be taken seriously."

It was thought therefore, that a careful investigation of the behaviour of the nucleus during budding was an essential introduction to a study of the cytogenesis of the yeasts.

The strain of *S. cerevisiae* (N.C.T.C. 3007) employed by us was SC 9 in the National Collection of Type Cultures, India. Wort cultures were made from wort-agar slants and conditions were standardized so that in a smear



almost all cells were practically at the same stage of development. Systematic examination demonstrated that vital changes take place in the nucleus at definite intervals and that the whole process of division of the nucleus takes only about 20 minutes. Indeed, the anaphase stage is passed through so quickly that unless one is very careful it may be missed completely.

Among the various fixatives and stains tried smears fixed in Carnoy and stained with

Heidenhain's hæmatoxylin were found to give excellent pictures. No particular treatment was found necessary to remove the metachromatic granules from the cells. In smears fixed for 60 minutes in Carnoy's fluid, mordanted overnight in iron-alum and kept in hæmatoxylin for 24 to 36 hours, careful differentiation gives only pictures of the chromosome stages. We have smears where large number of cells are at particular phases of the mitotic cycle.

There are only two chromosomes, both identical in appearance (Fig. 1). The measurements of the two chromosomes in four cells at the same stage of the cycle are as follows:—

(1)  $1.33 \mu/0.33 \mu$ ,  $1.33 \mu/0.4 \mu$ ; (2)  $1.33 \mu/0.4 \mu$ ,  $1.33 \mu/0.27 \mu$ ; (3)  $1.33 \mu/0.33 \mu$ ,  $1.00 \mu/0.33 \mu$ ; (4)  $1.00 \mu/0.33 \mu$ ,  $1.00 \mu/0.33 \mu$ . At anaphase shown in Fig. 2 they measure  $1.00 \mu/0.33 \mu$ .

Badian's paper has evoked contradictory opinions. While Guillermond rejects Badian's interpretations, Henri considers that "the two chromosomes described by him are more definite than the vague accumulations of minute chromatin granules described by Guillermond". It appears as if Badian saw structures missed by the other workers. *S. cerevisiae* does not form an exception to the general rule, for, nuclear division during budding is by mitosis.

Our thanks to Mr. M. Sreenivasaya for his active interest and encouragement. One of us (M.K.S.) wishes to thank Messrs. The K.C.P., Ltd., Uyyuru, for the generous grant of a studentship.

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February 1, 1945.

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## ON THE FOOD OF MULLET\*

MULLETS are a group of food-fishes found in seas, backwaters and estuaries of our country.

The food of twelve species of Mulletts is described by examining their stomach-contents.

- (1) *Mugil klunzingeri* Day. (30 specimens, 8-13 cms.): *Amphora*, *Cymbella*, *Pleurosigma*, *Eremosphaera*, Copepods and sand grains.
- (2) *Mugil jerdoni* Day. (15 specimens, 8-10 cms.): *Biddulphia*, *Coscinodiscus*, *Cymbella*,

*Fragillaria*, *Pleurosigma*, *Rhizosolenia*, *Eremosphaera*, *Peridinians*, larval bivalves, larval gastropods, fish-eggs, fish scales and sand grains. (3) *Mugil dussumieri* Cuv. & Val. (25 specimens, 8-10 cms.): *Coscinodiscus*, *Cymbella*, *Fragillaria*, *Gomphonema*, *Navicula*, *Nitzschia*, *Pinnularia*, *Pleurosigma* and sand grains. (4) *Mugil œur* Forskal (12 specimens, 9-10 cms.): *Biddulphia*, *Coscinodiscus*, *Navicula*, *Nitzschia* and sand grains. (5) *Mugil sehai* Forskal. (61 specimens, 9-21 cms.): Algal filaments, *Bacteriastrum*, *Biddulphia*, *Coscinodiscus*, *Fragillaria*, *Nitzschia*, *Pleurosigma*, *Rhizosolenia*, *Thalassiothrix*, *Trichodesmium*, larval polychaetes and sand grains. (6) *Mugil crenilabris* Forskal. (20 specimens, 10-15 cms.): *Coscinodiscus*, *Navicula*, *Pinnularia*, *Pleurosigma*, *Tabellaria*, larval polychaetes and sand grains. (7) *Mugil œeruleo-maculatus* Lacep. (30 specimens, 9-12 cms.): *Biddulphia*, *Chaetocera*, *Coscinodiscus*, *Navicula*, *Pinnularia*, *Pleurosigma*, larval polychaetes, *Tabellaria* and sand grains. (8) *Mugil amarulus* Cuv. & Val. (5 specimens, 5-8 cms.): *Coscinodiscus*, *Eremosphaera* and sand grains. (9) *Mugil labiosus* Cuv. & Val. (5 specimens, 5-8 cms.): Algal filaments, *Coscinodiscus* and sand grains. (10) *Mugil olivaceus* Day. (20 specimens, 7-9 cms.): *Bacillaria*, *Coscinodiscus*, *Fragillaria*, *Navicula*, *Pleurosigma* and sand grains. (11) *Mugil troschelti* Bleeker (123 specimens, 10-35 cms.): Algal filaments, sea-weed (*Caulerpa* sp.), *Chaetocera*, *Chroococcus*, *Cœlosphaerium*, *Coscinodiscus*, *Eremosphaera*, *Glœocapsa*, *Hemidiscus*, *Navicula*, *Nitzschia*, *Pleurosigma*, *Rhizosolenia*, *Tabellaria*, *Thalassiothrix*, *Foraminifers*, *Tintinnus*, larval polychaetes, *Nauplius* larvae, *Ostracods* and sand grains. (12) *Mugil waigensis* Quoy. and Gaim. (126 specimens, 10-45 cms.): Algal filaments, *Bacteriastrum*, *Biddulphia*, *Coscinodiscus*, *Detonula*, *Eremosphaera*, *Fragillaria*, *Gœlenkinia*, *Hemidiscus*, *Navicula*, *Nitzschia*, *Pleurosigma*, *Rhizosolenia*, *Tabellaria*, *Thalassiothrix*, *Trichodesmium*, *Dinophysis*, *Foraminifers*, *Tintinnus*, larval polychaetes, Copepods, Amphipods, *Ostracods*, larval gastropods and sand grains.

**Discussion.**—Mulletts are chiefly plankton-feeders, diatoms and larval bristle-worms forming the major portion of their food. They, however, supplement their diet by browsing at the water margin on vegetable matter, and this accounts for the presence of sand grains in their stomachs. The presence of fish-eggs in a few specimens of *Mugil jerdoni* Day. is considered accidental.

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## REVIEWS

**Climate and Labour.** By W. Burridge. (Kitabistan, Allahabad), 1944. Pp. 167. Rs. 5-4-0.

Men are often irrational and the student of Science is no exception. The scientist who is meticulous in his investigations may stubbornly uphold views which would not stand the test of rational analysis. We have a sample of the above in the volume with the pretentious title under review.

The reader's interest is piqued by the claim in the inside cover page that the work deals with "the physical build of the body and the dietetic conditions which render men so comfortable on a hot day that they fall asleep on a hot verandah while pulling a punkah rope. The author notes that the vast majority of the population of India must be capable of such work and sleeping, and that the capacity to do it fits a man to follow rather than to lead. The social system of Hinduism is adapted to such conditions rather than Western Democracy." It is reasonable, therefore, to enquire the basis on which such astounding conclusions are based. The reader is earnestly enjoined to appreciate that the author arrived at the conclusions not "as a result of questioning a dozen or so dyspeptics, but after assessing the replies of many hundreds, even thousands, of healthy young Indian male and female medical students to questions concerning their own hot-weather experiences". Since these replies were elicited at many written and oral examinations one begins to wonder how far testimony given under such conditions is valid and whether the students were really healthy? The picture of the Indian student is not very complimentary for, the author states: "It is further my experience that Indian students, especially the ladies, who read from morn to eve and long into the night for examination purposes do become anæmic. Indeed, more students appear to me to do badly through lack of sleep and overwork than from non-prosecution of studies" (p. 129).

The questions also appear to have been put in forms not conducive to elicit accurate replies, for, it is mentioned (p. 15): "Unfortunately, a limited number of the ladies appeared to imagine that this was an unjustified enquiry into the secrets of their bed chambers, and, therefore, I thought it better to put the question into a different form by going to the dogs instead. But, while the problem in its first form (how he or she lay in bed in the cold and hot weather respectively) could be answered by anybody who applied his book-learning to facts within his own personal experience, the second form required that the student should also be an ordinary observer of the world around him; yet many more students failed in the observation test than were young ladies shocked at imagined enquiries into bed-chamber secrets."

It is on this unscientific foundation that the author bases his conclusion that "Nietsche's doctrine of a herrenvolk and a heerden volk is a germanised version of what has been practised for centuries in India as caste" and that "the climatic conditions of India unfit it for democracy".

The book is interesting to read and is recommended to interested readers as an example of how so-called scientific facts could be made to fit in with one's preconceived notions.

M. K. SUBRAMANIAM.

**Sex Education.** By Cyril Bibby, M.A., M.Sc., F.L.S. (Macmillan & Co., London), 1944. Pp. 290. Price 7 sh. 6 d.

It has been a moot point whether some amount of sex education should be imparted to boys and girls of school-going age. Orthodox public opinion was against such a procedure, but it has been changing during the past few years. The majority of teachers and youth leaders, especially in advanced countries like England and America are in favour of sex education. It is now considered advantageous to impart sex education to youths from a biological point of view rather than allow them to discover things for themselves at an age when emotions begin to assert themselves. Children are curious to know about how babies are made, and about the differences between boys and girls; and young questioners on these points should be gladly and honestly answered. The author insists on the necessity for all teachers to take a course in human and social biology. "If we draw up careful schemes of instruction about how to calculate the time it will take for an express train to get from London to Glasgow or a camel from Cairo to Timbuctoo, is it not rather astonishing that instruction about how life is passed on, and about the relations between man and woman and parent and child, should be left for any chance lesson at the street-corner or in the gutter?"

He is of the opinion that sex education should be a continuous process from the cradle to the grave. The parent, the teacher, and the youth leader ought to know what aspects of sex education are particularly appropriate to different ages. The facts of reproduction in plants and animals should find a place in the biology lessons, which should be made compulsory in all schools.

The four model lectures at the end are masterpieces of how this delicate subject may be handled without being either indecorous or offensive. An excellently classified bibliography on the subject is given at the end of the book for guidance to further reading. The book is well worth a careful study by all parents and teachers.

S. SUBBA RAO



**Flowers in Britain.** By L. J. F. Brimble. (Macmillan & Co., Ltd., London), 1944. Pp. x + 393. Price 12 sh. 6 d.

This attractively produced popular book on flora of Britain would be welcomed by plant lovers in many countries. The title *Flowers in Britain* may suggest to some that the usefulness of the book to those outside Britain would be limited. This is far from the fact. Many of the families of the flowering plants and several of the species described occur in India. The ornamental plants described and so well illustrated are not unfamiliar to plant lovers and amateur gardeners in this country. Apart from this the value of the book lies in the fact that to those really interested in flowers a popular book of this kind would help in visualising the richness and beauty of the flora of another country than one's own.

The author's treatment of the subject is such as to appeal most to laymen not much conversant with botany, yet, the book would be found very useful to students of botany in High Schools and those of the Intermediate standard in Colleges. In the introductory part of the book the author has explained in simple terms some of the elements of botany an acquaintance with which would help the laymen in an intelligent understanding of the principles of plant classification and the necessity for plant systematics. A welcome feature of the book is the division of each family into three groups, namely, wild, ornamental and economic plants. The reason for this as explained by the author is to draw the attention of the laymen and others interested in plant-life to the fact that economic and ornamental plants have in the wild types their near or distant relatives to whom their descent could be traced. The division of each family into these three groups shows further their inter-relationships.

The entire text is enlivened by the addition of appropriate verses from ancient and modern poets, by giving references to the occurrence in historical times of plants now growing and by mentioning the use made of plants by personages renowned in history. Wherever possible the author has indicated the possible origin of plants and the probable dates of their introduction. Such a treatment as the foregoing makes the reading of this book pleasant and interesting instead of its being one more book of mere mechanical description of plants in dry technical terms. The book is not intended as a standard work of reference but as a guide or companion to amateur gardeners, to rambles through countryside and to those who hobby in plant collection. To such of these, of whom there would be many in every country, this book is specially intended.

The author has to his credit other books in botany, both technical and popular. Those familiar with his book *Everyday Botany*, will be pleased with this new addition. Considering the time at which the book has appeared, its neat and attractive get-up is to be praised. To suggest that use of superior paper would have enhanced the value of such a well-illustrated book would in these days of paper restrictions sound supercilious. Even other-

wise, the excellence of the publication is to be highly commended. It should be said in praise of the author, printer and publisher that it is indeed creditable that in spite of the stress and strain of war to which Britain has been subjected they should have found the time and energy to bring out a book which can divert the minds of men from the horrors and devastations of war to the haven of peace and beauty of nature.

L. S. S. KUMAR.

**A Text-Book of Plant Physiology.** By Shri Ranjan. (Indian Press, Ltd., Allahabad), 1945. Pp. 228. Figs. 81. Price Rs. 6.

The author should be congratulated for bringing out the first text-book of Plant Physiology in India. The lack of an elementary text-book suitable to Indian University curricula was being keenly felt and this book very much satisfies the needs of the B.Sc. students of botany in our country.

The book is well planned and one chapter follows another in logical sequence. The various aspects of Plant Physiology are well treated and the student gets a good elementary idea of the subject. Chapter III—The metabolic biography of a pea—seems to be unnecessary. The practical experiments at the end of each chapter will be found useful by both students and teachers. This would have been better appreciated if the experiments had been described at some length. In many places the value of the book would have been very much enhanced if the author had gone into greater detail. In trying to be brief, the statement is made on page 70—"From the condensation of glycine higher proteins are formed"—this is rather misleading. In the chapter on growth, the latest developments in the field of hormones in plants should have been included. Treatment of photo-periodism in plants should not have been omitted in a text-book of this kind. In mentioning the names of several plant physiologists the author has given dates but has not included a bibliography. At least a list of books for supplementary reading would have been very useful. The appendix on logarithms finds no place in this book. The book is well printed in bold type with numerous illustrations and can be recommended to students.

N. N. N.

**The Plant Scientist in the World's Turmoils.** Contribution to the symposium "Biologists and Rehabilitation", delivered by Dr. Frans Verdoorn of "Chronica Botanica", Waltham, Massachusetts, at Cleveland, Ohio, September 13, 1944.

It looks as though it needs a war to bring any scientific recluse out into the sphere of free thinking in terms of National and International building up of newer methods of research and collaboration—hitherto a little known domain. Dr. Verdoorn's remarkable little six-page document is thought-provoking and contains a clarion call to Biologists all over the world to unite and plan out a constructive future in a world of peace. The author in his own forceful and inimitable style presents a

very strong case for a truly international scientific organization which will not exclude Germany and German split States in order "that the German Scientist, still always one of the world's foremost, will not go 'underground'." Still in the same breath the author says, "the resources of the Allies are bringing this war to an end, an end which will place the scientist once again in a very favourable position, as he will remain free in the post-war world, not in all but in much more than half of the Allied Territory". To biologists and scientists in general in Allied Territory this statement is disconcerting. Let us not, at any rate, presume that Dr. Verdoorn presupposes that freedom to the scientist is inter-related with freedom in politics! In the matter of International biological collaboration, extending his own argument further, the author quotes from the United Nations Conference on Food and Agriculture that "the natural sciences are a particularly fruitful field for international co-operation because they are themselves international; basic, physis and biological laws are the same anywhere and universally accepted"; but he says, "co-operation demands an attitude which is not typical of the average biologist". There is great deal of truth in this statement as biological research so far has remained very individual. Nevertheless, the cry for team-work in biological sciences has never been greater than to-day when many

biological problems need Applied than Fundamental research. This fact has been very usefully brought out by Dr. Verdoorn. To the thinking biologist the author has given large number of suggestions as to what great quantities of untapped knowledge lay undiscovered and which could be unearthed by improving scientific publications, by instituting abstracting journals, international as well as regional, by truly international societies and commissions for co-operative research and in a host of other ways. The answer to this intriguing question of whether a world federation of biologists will work or not is found in the author's statement, "among biologists all over the world there is a feeling that relations with government (I do not mean any specific political group) should be avoided whenever possible. This may be a sound attitude from the point of view of pure research; from all other points of view it is a mistake. It reveals poor ability to read the signs of the times. Who should know better than the biologist that with the development of organisms their ecology becomes more and more intricate?"

This contribution by Dr. Verdoorn is scintillating reading and is a blunt message not only to the biologist but to the International Scientist. In his own words; "the politician, let us never forget, has to emphasize what divides; the scientist may well emphasize what unifies".

T. S. SADASIVAN.

## THE PLACE OF ANGIOSPERM EMBRYOLOGY IN RESEARCH AND TEACHING\*

**L**ITTLE that is fundamentally new has been discovered in recent years in the field of descriptive embryology, although many errors and misinterpretations made by previous workers have been corrected and a mass of information added concerning the male gametes, development of embryo-sac, fertilization, endosperm and embryo. In recent years considerable progress has been made chiefly in Europe and America in the field of phylogenetic embryology. The data sifted out from microscopic observations have been made use of in determining the apt positions of certain groups, tribes or families in a natural system of classification. Thus, Empetraceae has come to be placed with the Bicornes, Lennoaceae under Tubiflorales as a separate sub-order, Cactaceae under Centrospermales and Moringaceae (with Cappariaceae) under Rhœdales; the genus *Trapa* which has long been placed under Onagraceae, becomes removed from that family on embryological grounds. Further, some of the embryological characters have been employed to understand the classification within a family as in the case of Liliaceae and Amaryllidaceae. When an exhaustive study of all aspects of embryology of a group or family is made, it would be worth developing an 'embryological formula' for each group or family.

\* Abstract of Presidential Address by Dr. P. Maheshwari of the Dacca University, delivered before the Annual Meeting of the Indian Botanical Society held at Nagpur on 3rd January 1945.

From the last two decades a new offshoot, the applied and experimental embryology has emerged out. A thorough knowledge of the sequence of events in the flower is an absolute requisite for success in breeding programmes and in the improvement of crop plants. Though this aspect is still in its infancy, the results obtained till now show a very promising future. It would be very profitable to study in detail the optimum conditions for pollination and fertilization and the effect of X-rays and colchicine on the life-history, the results of which will be highly useful in plant betterment.

In addition to the commonly employed method of serial sectioning in the study of embryology, 'whole-mount' stained preparations which are rendered transparent are of great aid for correct interpretation. Such methods would also facilitate observations of living material under the microscope. A deep, thorough and critical observation alone is capable of bringing out a work of considerable importance; and in teaching, even if the laboratory work makes greater demands upon the energy and resourcefulness of the teacher, this should not be grudged, as through this the young pupil gets such a stimulus for his mental development as is sure to be of use to him ever afterwards in his future career.

In India, with its wealth of Tropical Flora, there is much scope for phylogenetic embryology. There are still several families whose embryological characters are not known or

need amplification. A thorough study of these would make it possible for us to bring out a most exhaustive and up-to-date treatise on embryology, in which each worker will write about his own specialised aspect or group, as literature on the subject is now too vast to be surveyed in a satisfactory manner by any one person. Again, a thorough knowledge of the

ontogeny of the components of the flower from the time of its inception up to the time of dispersal, alone would aid us to eliminate most of the obstacles in plant improvement and it would no longer remain for the breeder to put pollen on the stigma and 'pray' for results in the ovary!

B. G. L. S.

## ST. JOSEPH'S COLLEGE, TRICHINOPOLY, CENTENARY CELEBRATIONS

**S**TARTING from humble origins at Négapatam in the 1844, St. Joseph's of Trichinopoly had grown into a mighty Centenarian by 1944 and this happy event was celebrated in February 1945. Even before the Centenary Week was at hand its jubilant prospects were obvious to all, thanks to the Inter-Collegiate sports and tournaments which attracted immense crowds to the Mahé Grounds. The week following 8th February 1945 witnessed the College and the Hostels attached to it teeming with guests, resident and otherwise. The occasion was also marked by the jubilation of the College Day Celebrations and the revitalisation of the Old Boys' Association.

An Exhibition consisting of the Departments of Mathematics, Physics, Chemistry, Botany and History was organised in connection with the Celebrations. Sir V. T. Krishnamachariar, K.C.I.E., delivering open the Exhibition, referred to his connection with the College and expressed his admiration for the enormous strides advanced by the institution these years. He stressed the importance of Universities in training the future leaders of the country and the necessity "to rethink and replan the system more intimately to the natural balance of human life and human prosperity". With visitors drawn from the public and the student world the Exhibition was open for three days and it was a success both from the academic and from the popular points of view.

The Centenary Meeting, held on 9th February, was presided over by His Excellency the Hon'ble Sir Arthur Hope, G.C.I.E., M.C., Governor of Madras. His Excellency paid a glowing tribute to the services rendered by the College during the past hundred years in the cause of education, irrespective of caste or creed. Rev. Fr. Rector, in his report, briefly traced the growth of the College since its inception, enumerating the hardships it had to go through at the hands of man and God. He also read messages from Sir S. Radhakrishnan, Sir C. V. Raman, Sir C. R. Reddy, Sir Mohammad Usman, the Archbishop of Bombay and the Apostolic Delegate of the East Indies. Khan Bahadur P. Khalifulla Sahib, First Member, State Council, Pudukottah, extended the greetings on behalf of the Centenary Central Organising Committee. Dewan Bahadur T. M. Narayanaswami Pillai, Member, Public Services Commission, Madras, recalled his association with the College and wished it crowning success in the future. After a vote of thanks from the Very Rev. Fr. A. Bonhoure, S.J., Vice-Provincial of Madura, the meeting came to a close.

The distribution of Prizes for the Centenary Inter-Collegiate Sports was held under the presidency of His Highness Sri Brihadambada Raja Rajagopala Tondaiman, Bahadur, Maharaja of Pudukottah. His Highness spoke of the high place that St. Joseph's held in the academic as well as in the athletic fields among the pioneer colleges of S. India.

Realising the dire necessity of a spacious and well-furnished library and a comfortable reading room, the management proposed to institute a Centenary Memorial Library, the Foundation-Stone of which was laid by Mr. D. D. Antony Isar, M.B.E., B.A., LL.B., Administrator, Baghelkhand States Group, Central India.

A social gathering of the Old Boys of St. Joseph's was assembled in the New Hostel Quadrangle under the distinguished presidency of Mr. Antony Isar. Prof. P. E. Subramania Iyer, Retired Head of the Department of Physics and ex-Secretary of the Old Boys' Association, was also present. Speeches were made by His Lordship the Rt. Rev. P. Thomas, D.D., Bishop of Bangalore, Dr. T. S. S. Rajan, L.R.C.P., M.R.C.S., ex-Minister of Madras, Sri C. V. Narasimhan, M.A., I.C.S., and Sri. Papali, M.A., Ph.D., of H. H. the Maharaja's College, Ernakulam. Rev. Fr. J. D'Souza, S.J., Principal, Loyola College, Madras, proposed a vote of thanks.

The College Day was celebrated with Lt.-Col. Sir A. L. Mudaliar, Vice-Chancellor, University of Madras, in the chair. Dr. Mudaliar referred to the inestimable services rendered by the College in the cause of higher education and remarked that missionary activities are sure to occupy a sound and proper place in the social and educational setting of the India of tomorrow.

On the 11th February a meeting of the Catholic Former Pupils was held in the Lawdley Hall, presided over by His Excellency The Delegate Apostolic of the East Indies. Rev. Fr. Jerome D'Souza, S.J., Rector and Principal, Loyola College, Madras, welcomed the gathering. A congratulatory address was delivered by Rao Bahadur J. C. Ryan, M.A., Joint Registrar of Co-operative Societies, Madras. Mr. Joseph Thalith, M.A., Bar-at-Law, Retired Chief Justice of Travancore, also addressed the gathering.

A civic reception was accorded to Rev. Fr. Rector in the Municipal Public Hall.

With the Car Procession and a grand Pyrotechnic Display, the Celebrations came to a happy close.



## SCIENCE NOTES AND NEWS

The Watumal Foundation of Honolulu and Los Angeles has announced the award of thirteen scholarships and one travelling fellowship to candidates from India chosen from among 1,200 applicants.

The travelling fellowship has been awarded to Dr. J. Makhijani, of Hissar, in the Punjab, Animal Geneticist, to study dairy industry and genetics. The thirteen recipients of the scholarships include Mr. A. N. Bindal, Research Assistant, Indian Institute of Science, Bangalore, to study fermentation and biochemistry; Mr. H. D. R. Ayyangar, of Bangalore, for research in fishery; Sardar Gurbaxani, Research worker in the Department of Biochemistry, Indian Institute of Science, Bangalore, to study sanitation. Two women, Dr. (Miss) Zubaida Nasir Uddin, formerly of the Punjab University, and Miss Tara Deodhar of Bombay, have also received scholarships.

To ensure an adequate supply of technical personnel to meet the demands of the administrative services and industrial development in the country in the post-war period, the Government of India have appointed a Committee, with Mr. N. R. Sinker as its Chairman, to consider the establishment of a high-grade Technological Institute in India, to provide advanced instruction and training in Technology. The following have been invited to serve on the Committee: Mr. N. R. Sinker (Chairman), Mr. A. D. Shroff, Mr. W. W. Wood, Dr. Sir J. C. Ghosh, Dr. Nazir Ahmad, Mr. C. E. Preston, Mr. W. W. Ladden, Mr. M. D. Parekh, Dr. Sir S. S. Bhatnagar, Mr. J. K. Srivastava, Mr. G. I. Mehta, Sir Sobha Singh, Major-General D. R. Duguid, Brig. R. D. T. Woolfe, Mr. W. G. Reid, Sir Frederick Tymms, Mr. P. J. Edmonds, Mr. H. V. R. Ayyangar, Dr. A. H. Pandya, Mr. S. Lall, Mr. Dharma Vira and Mr. John Sargent.

Sir Herbert Howard has been appointed Adviser to the Government of India on Forestry with headquarters at New Delhi. He will be succeeded by Mr. Simmons as President of the Forest Research Institute.

Prof. R. A. Fisher, the well-known statistician, has arrived in India to advise the authorities on the reorganisation of the Indian Statistical Institute at Calcutta. The Government of India have decided to reorganise this Institute by recognising it as a private body with legal status. Prof. Fisher's headquarters will be transferred to Delhi as soon as practicable. While in Delhi, he will advise the Government of India on statistical matters.

Professor Raymond E. Kirk, Dean of the Graduate School and Head of the Department of Chemistry, and Professor Donald F. Othmer, Head of the Department of Chemical Engineering, Polytechnic Institute of Brooklyn, have taken over the editorship of an *Encyclopedia of Chemical Technology*. This Encyclopedia will be published by Interscience Encyclopedia, Inc., and distributed by Interscience Publishers, Inc., New York.

Chemical products and processes as well as the equipment of the chemical industry will be described in considerable detail. An alphabetical arrangement will be followed and the articles will be signed by the contributors. The tentative plan provides for the publication of 10 volumes of approximately 900 pages each. The first volume is scheduled to appear in April 1946, and the tenth volume will appear in April 1949.

An editorial office has been organized in close proximity to the Polytechnic Institute of Brooklyn. Miss Janet D. Scott, formerly with "Chemical Abstracts" and the Calco Chemical Division, American Cynamid Co., will act as assistant editor in charge of this office. An editorial board is being selected.

Current American practice will be stressed in this work designed for American chemists and chemical engineers.

At the Annual General Meeting of the National Institute of Sciences of India, held on the 2nd January, 1945, at the Science College, Nagpur, the following were duly elected Officers—bearers and members of Council, for the year 1945:—

**President:** Mr. D. N. Wadia; **Vice-Presidents:** Prof. S. P. Agharkar and Sir S. S. Bhatnagar; **Treasurer:** Rai Bahadur K. N. Bagchi; **Foreign Secretary:** Prof. D. S. Kothari; **Secretaries:** Rai Bahadur S. L. Hora and Dr. W. D. West; **Editor of Publications:** Prof. J. N. Mukherjee; **Members of Council:** Prof. P. R. Awati, Dr. N. Bagchi, Dr. S. K. Banerji, Prof. H. J. Bhabha, Khan Bahadur M. Afzal Husain, Prof. M. O. P. Iyengar, Prof. P. C. Mahalanobis, Dr. K. G. Naik, Dr. B. N. Prasad, Dr. H. S. Pruthi, Prof. M. Qureshi, Mr. B. Rama Rao, Dr. L. A. Ramdas, Prof. P. Ray, Rai Bahadur J. M. Sen, Dr. A. C. Ukil, and Dr. K. Venkataraman.

## MAGNETIC NOTES

Magnetic conditions during February 1945 were slightly more disturbed than in the previous month. There were 15 quiet days and 13 days of slight disturbance as against 10 quiet days, 9 days of slight disturbance and 1 day of moderate disturbance during the same month last year.

The quietest day during February 1945 was the 21st and the day of the largest disturbance the 15th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	
1, 3, 7, 10-13, 18-22, 24, 25, 28.	2, 4-6, 8, 9, 14-17, 23, 26, 27.	

No magnetic storms occurred during the months of February in 1944 and 1945.

The mean character figure for the month of February 1945 was 0.46 as against 0.38 for February 1944. M. PANDURANGA RAO.



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